

NAVAL POSTGRADUATE SCHOOL MONTEREY, CALIFORNIA



THESIS

AN ANALYSIS OF THE FINANCIAL RATIOS OF TAIWAN EXPORT INDUSTRIES

by

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September, 1995

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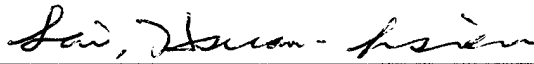
**AN ANALYSIS OF THE FINANCIAL RATIOS OF TAIWAN'S EXPORT
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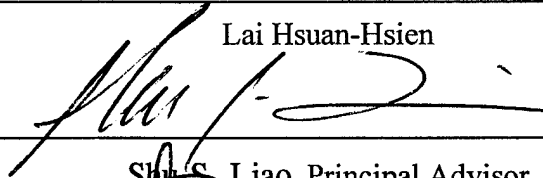
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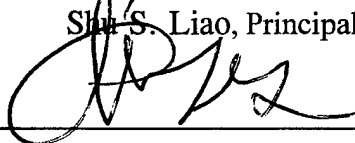


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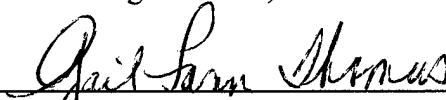
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ABSTRACT

The Republic of China's exports account for somewhere between 45 and 60% of its GDP. The Republic of China has maintained very high foreign currency reserves. The United States Government has accused the central bank of manipulating its currency by keeping it artificially low to protect the ROC's domestic markets. In recent times the NT\$ has appreciated against the U.S. dollar from 40 to one in 1986 to 26 to one in 1990. The objective of this research is to study the financial statements of the export industries and examine selected financial ratios to answer two questions. Question 1: Has the export industry conditions significantly change during the appreciation of the NT\$ from 1986 to 1993? Question 2: Was the financial condition of the export industry related to the stability of the NT\$? More specifically, was the financial condition of the export industry more stable during the 1990-1993 period than during the 1986-1989?

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I. INTRODUCTION

A. BACKGROUND

The Republic of China (ROC), generally known as Taiwan, is a relatively small island, in its current form for fewer than 45 years. During most of that period, it has been threatened to a greater or lesser extent with takeover by the much larger People's Republic of China (PRC), survived the social tensions occasioned by the presence of a subordinate local majority, and struggled to maintain and develop itself as a viable independent entity in a restricted territory that has few available resources.

Some two-thirds of Taiwan are mountains, and only 24 percent is arable. About 55 percent is forested, mostly in the upland areas, while 5 percent is grassland, and 16 percent is classed as "other", which includes developed urban areas, island waters, and bare ground. The island is poor in natural resources, and the few strategic resources that it does possess are inadequate to meet domestic needs. From its beginnings, Taiwan has focused on value-added trade to secure what it lacks and gain the resources that it needs to develop its economy.

From 1952 to the end of 1993, Taiwan's annual average real GDP growth was an impressive 8.6 percent. During this time, the economy was transformed from being predominantly agricultural to manufacturing and services based, while keeping its foreign debt very low and improving its distribution of income. Exports have been the prime engine of economic growth.

Taiwan's economy is dominated by foreign trade on the demand side and manufacturing on the supply side. Exports account for 45-60 per cent of current GDP from 1980-1990. Some 97 percent of all Taiwanese firms are small- or medium-sized and privately owned, and about 85 percent of Taiwan's workers are employed by small business. Such operations play a correspondingly large role in the nation's economy. One of Taiwan's strengths is its small, usually family-owned and operated businesses.

Taiwan's main exports are machinery and electrical equipment and textiles, which together account for about half of its total exports. Basic metals and metal articles; plastic and

rubber products; footwear and related items; transportation equipment; toys, games and sporting goods; precision instruments (including clocks, watches, and musical instruments); animal products; and chemicals account for an additional third of the exports. Together, these ten categories account for 87 percent of Taiwan's exports. Other export product categories each account for less than 2 percent of the total.

Taiwan's international reserves generally has maintained the largest reserves in the world in recent years. The largest portion of Taiwan's reserves represents trade with the United States, its main trading partner.

Due to Taiwan's huge foreign currency reserves and balance of trade surplus, the US government in particular has accused the Central Bank of China of manipulating its currency and keeping it artificially low to protect its markets. Nevertheless, the New Taiwan dollar has appreciated by about 60 percent against the US dollar since 1985, moving from its 40 to 1 rate in the late 1970s and 1980s to its 26 to 1 rate in 1994.

Year	1986	1887	1988	1989	1990	1991	1992	1993
Begin of Period	39.4	35.3	28.6	27.8	26.1	27.2	25.1	25.4
End of Period	36.0	28.9	28.2	26.1	27.1	25.7	25.4	26.6

Source: US Federal Reserve System

Table 1. Exchange Rate NT\$/US\$

The competitiveness of Taiwan's exports to the USA is greatly affected by the exchange rate between the NT dollar and the US dollar. [Ref. 6]

B. OBJECTIVE

Because exports have been the prime engine of economic growth, Taiwan's economy is dominated by foreign trade on the demand side and manufacturing on the supply side. The competitiveness of Taiwan's exports is greatly affected by the exchange rate. In this study, the objective is to use the financial statements of the export industry and examine selective

financial ratios to evaluate the financial condition of Taiwan's export industry. Two central research questions will be addressed:

- Has the industry condition significantly changed during the appreciation of NT\$ from 1986 ~ 1993?
- Was the stability of the financial condition of the export industry related to the stability of the NT\$? More specifically, was the financial condition of the export industry more stable during the 1990-1993 period than during the 1986-1989?

C. ORGANIZATION OF STUDY

Chapter II contains a review of using times series analysis to relate financial ratios. Chapter III is an explanation of the methodology used for analysis in this study. The selection of sample firms, of data items, and of the financial ratios, and the statistical tests used in the analysis are discussed. Chapter IV describes the analysis of profitability ratios. Chapter V describes the analysis of leverage ratios. Chapter VI describes the analysis of liquidity ratios. Chapter VII describes the analysis of activity ratios. Chapter VIII concludes the results of the research.

II. TIME SERIES ANALYSIS

A. INTRODUCTION

Financial statement analysis is an information-processing system designed to provide data for decision makers. Users of the financial statement information system are decision makers concerned with evaluating the economic situation of the firm and predicting its future course. Financial ratio analysis is the major tool used in the interpretation and evaluation of financial statements for investment decision making. Financial ratios are conventionally analyzed in two ways: time-series and cross-sectional analyses. The former is concerned with the behavior of a given ratio over time, while the latter involves comparisons between the investigated firm's ratio and those of related firms.

A major objective of analyzing financial ratios is to predict future values of the ratios. The general approach to such discrete time series predictions is to search for systemic patterns in the historic behavior of the series; knowledge of such patterns can then be used in the prediction process.

Understanding and describing the time series properties of accounting earnings has received considerable attention by researchers in accounting since those early studies. So-called time series research now occupies an important position in the empirical accounting literature.

In this study, the data cover a period of eight years which are not enough to analyze the time series pattern of financial ratios of Taiwan's export industry. The literature review, includes a discussion of time series characteristics of financial ratios, but the data analysis will not include the time series financial ratio patterns of Taiwan's export industry.

B. TECHNIQUES COMMON TO RATIO TIME SERIES ANALYSIS

1. Random Walk

Random walk is a process for time series forecasting which assumes the value $Y_1, Y_2, Y_3, \dots, Y_t$ in the series are drawn randomly from a probability distribution. In completely general form, the time series process assumes that the series Y_1, Y_2, \dots, Y_t is a set

of jointly distributed random variables, i.e., that there exists some probability distribution function $p(Y_1, ..., Y_t)$ that assign probabilities to all possible combinations of values of $Y_1, ..., Y_t$. If we could somehow numerically specify the probability distribution function for time series, then we could actually determine the probability of one or another future outcome.

Unfortunately, the complete specification of the probability distribution function for a time series is almost always impossible. However, it is possible to construct a simplified model of the time series which explains its randomness in a manner that is useful for forecasting purposes. In the simplest random walk process, each successive change in Y_t is drawn independently from a probability distribution with zero mean. Thus, Y_t is determined by:

$$Y_t = Y_{t-1} + e_t \quad , \quad (1)$$

with $E[e_t] = 0$ and $E[e_t, e_s] = 0$ for $t \neq s$. Such a process could be generated by successive flips of a coin, where a head receives a value of +1 and a tail receives a value of -1. [Ref. 13: p. 9] For a concise random walk process in a financial ratio, financial ratio changes that appear as if they have been generated by the flip of a fair coin have the random walk property. Each ratio change is independent of all past ratio changes, and the best guess of next period's ratio is the reported ratio for the present period. The sequence of past ratio changes, therefore, is of no help in predicting future ratio changes. A strict random walk process also generates ratio changes that have constant volatility over time.

2. Differencing

Differencing a time series as used to calculate the difference between diverse elements in the time series, Such as a first-differenced series, second-differenced series, ..., fourth-differenced series. A first differenced series of financial ratio time series shows more evidence of stationary than does other difference series or a no difference series.

The first difference of a time series are the difference between two consecutive time periods series. The first differences of the time series, $\Delta X_t, \Delta X_{t-1}, ...,$ are calculated:

$$\begin{aligned}\Delta X_t &= (X_{t-1} - X_{t-2}), \Delta X_{t-1} = (X_{t-2} - X_{t-3}), \dots, \\ \Delta X_{t-n} &= (X_{t-n} - X_{t-n-1}) \quad .\end{aligned}\tag{2}$$

The first differences of time series can be related by using auto-correlation function to describe the behavior of ratio series over time.

3. Auto-Correlation Function

An objective of autocorrelation analysis is to develop tools for describing the association or mutual dependence between values of the same time series at different time periods. Patterns in autocorrelations can be used to analyze corresponding patterns in the data, and help in the interpretation of time series. [Ref. 8: p. 69]

The autocorrelation describes the association (mutual correspondence) of the successive values of the data [Ref. 12]. The degree of this correlation is measured by the correlation coefficient, which varies between +1 and -1. A value close to +1 implies a strong positive relationship between the two variables, which means that when the value of one variable increases the value of the other also increases. Similarly, a correlation coefficient close to -1 indicates the opposite that increases in one variable will be associated with decreases in the other. A coefficient of zero implies that no matter what happens to one variable nothing can be said about the value of the other. [Ref. 12: p. 134]

The autocorrelation coefficients of random data have a sampling distribution that can be approximated by a normal curve with mean zero and standard error $1/\sqrt{n}$. This means that 95% of all sample-based autocorrelation coefficients must lie within a range specified by the mean plus or minus 1.96 * standard errors, when the data are random. That is, the data series can be concluded to be random if the calculated autocorrelation coefficients are within the limits [Ref. 12: p. 259]. Based on this knowledge, confidence intervals can be constructed and used to determine the chances that a given autocorrelation will be significantly different from zero. This can be used as a rough rule to determine that a 95% confidence interval will require an autocorrelation to be more than about $2/\sqrt{n}$ in order to be significant [Ref. 12: p. 337].

4. The Time-series Pattern of Financial Ratios

The first difference of a financial ratio is characterized by a constant expectation, or mean-reverting process, implying that a financial ratio, Y_p , is a random variable whose expectation (i.e., mean value) remains constant over time. Specifically, suppose that the behavior of a financial ratio is described by the following process:

$$Y_t = \mu + \mu_t \quad (3)$$

Where μ is the expected value of financial ratio and μ_t is a random disturbance term having a zero expected value.

Expression 3 implies that the average periodic financial ratio is expected to be stable over the long run at the level of μ . When a financial ratio expectation (mean value) is constant over time, an actual ratio will tend to revert to the mean. Specifically, a financial ratio that is in a given period higher than the mean will, on the average, be followed by lower financial ratio, and vice versa. The tendency of actual ratios to revert to the mean from either side results in a negative dependency in the time series of ratio changes. Thus, when a ratio in a given period has increased to an extraordinarily high level relative to average ratio, one would expect a decline in the following period's ratio. Thus, positive ratio changes will, on the average, be followed more frequently by negative changes than by positive ones, and vice versa. [Ref. 10: p. 120]

When the expectation of the ratio is a known function of time, ratio-changes will tend to be followed by changes of the same sign. However, the first difference serial correlation of ratio changes will be negative, since the deviations of the ratio from the trend line will behave as a mean-reverting process. In other words, a positive deviation from the trend line in period t will be followed more frequently by a negative deviation than by a positive one. Thus, while ratio changes will usually follow the same sign, deviations from the mean (depicted by the correlation coefficient) will usually follow the opposite sign.

The difference between the constant expectation and the expectation that is a function of time is: The mean of the first difference will be zero, if the process is characterized by a constant expectation, Whereas in a process characterized by an expectation that is a

deterministic function of time, the mean of the first difference in ratio will be nonzero. [Ref. 10: p. 121]

The first difference of a financial ratio is characterized by a constant expectation, which means there is no time dependence between data values any number of time periods apart. Thus, the mean of the first difference will be zero. When the mean of the first difference of a ratio shows zero, this means that the ratio follows a random walk model. Whereas if the mean of the first difference of a ratio is a deterministic function of time, the mean of the first difference will be nonzero, reflecting the trend. [Ref. 10: p. 124]

III. METHODOLOGY

A. INTRODUCTION

The approach used to conduct the analysis for this study consisted of six steps. The steps were: (1) identifying the sample firms, (2) collecting the data for the sample, (3) identifying the ratios to be analyzed, (4) identifying the statistical tests, (5) plotting the mean/mean of absolute of first difference of ratios, and (6) interpreting the outcome of the statistical test.

B. IDENTIFICATION OF SAMPLE AND DATA COLLECTION

1. Sample Identification

The sample used for the analysis in this study consisted of 50 firms from Taiwan's export industries which reported their financial statements to the Taiwan Securities and Stock Commission from 1986 through 1993. The export industries chosen in this study consisted of (1) plastic, (2) textile, (3) chemical, (4) steel, (5) electronics. The 50 firms chosen are listed in Table 2. The primary factors in deciding on sample selection were: (1) those industries are the main export industries of Taiwan which experienced NT\$ appreciation during the period of 1985-1993, (2) those firms have listed stock in Taiwan stock market and reported their financial statement to the Taiwan Securities and Stock Commission annually. By the end of 1994, 315 firms listed stock on the stock market, nearly 200 firms of which listed stock after 1990. Those sample industries and firms covered a broad spectrum of the Taiwan export industry that fit the criteria of sample selection.

2. Selection of Financial Data

Financial data were chosen to provide for calculation of a wide range of ratios. Because in recent years Taiwan Securities and Stock Commission wanted to offer public investor and creditor more information about listed firms, it designed a standard format for financial statements and all kinds of financial ratios and put the statement and ratios into spreadsheet format for using Lotus or Excel software to calculate. The standardized financial

statements and financial ratios are listed in Table 3. This study selected 13 of the ratios analyses.

Plastic Industry	
1.	Formosa Plastic
2.	Nan Ya Plastic
3.	USI Far East
4.	China General Plastics Corp
5.	San Fang Chemical
6.	Asia Polymer
7.	Taita Chemical
8.	Taiwan Styrene Monomer
9.	Taiwan Polypropylene
10.	Grand Pacific Petrochemical
Textile Industry	
1.	Far East Textile
2.	Hualon-Teijran
3.	Chung Shing Textile
4.	Shinkong Synthetic Fibers
5.	Nan-Yang Dyeing & Finishing
6.	Carnival
7.	Reward Wool
8.	Taroko Textile
9.	Formosa Taffeta Co., Ltd
10.	Hung Chou Chemical
11.	Dong Ho Textile
12.	Kowng Fong Industries
13.	Tong-Hwa Synthetic Fiber
14.	Sinkong Spinning
15.	Rurentex Ind.
16.	Min Hsing Cotton Mill

17.	Lucky Textile
18.	Shin Yen Ind.
19.	Chun Fu Textile
Chemical Industry	
1.	Lee Chang Yung Chemical Ind.
2.	Southeast Soda
3.	Formosan Union Chemical
4.	Everlight Chemical
5.	Chen Hong Chemica
Steel Industry	
1.	Hung Ho Steel
2.	Yieh-Hsing
3.	First copper & Iron
4.	Chun Yuan Steel
5.	Tahchung Iron of Superior Quality
6.	Ulead Ind.
7.	Kao Hsing Chang Iron & Steel
Electronics Industry	
1.	Liton Electronic
2.	United Micro Electronics
3.	A.D.I.
4.	Microtek International, Inc.
5.	Delta Electronic
6.	Rectron Ltd.
7.	ACER

Table 2. Export Industries Chosen for Study

FINANCIAL STATEMENT	
Assets	
Current Asset	
Cash	
Marketable Securities	
Accounts Receivable	
Allowance for Bad Debt	
Inventory	
Other Current Assets	
Total Current Assets	
Long term Investment	
Fixed Assets	
Land	
Plant	
Equipment	
Accumulated Depreciation	
Other Assets	
Total Assets	
Liabilities and Shareholder's Equity	
Current Liabilities	
Short term Debt	
Account Payable	
Accrued Expense	
Other Current Liabilities	
Total Current Liabilities	
Long Liabilities	
Long term Debt	
Other Long term Debt	
Other Liabilities	
Pension	
Total Liabilities	

Shareholder's Equity	
	Common Stock
	Preferred Stock
	Retained Earnings
Total Stockholder's Equity	
INCOME STATEMENT	
Net Sales	
	Cost of Goods Sold (COGS)
Total Operating Expenses	
Net operating Income	
Interest Expense	
Net Income before Tax	
	Income Tax Expense
Total Income from continuing Operations	
Net Income	
Earning per share from continuing operations	
FINANCIAL RATIOS	
1.	Equity to Assets
2.	Debt ratio
3.	Times Interest earned
4.	Current Ratio
5.	Quick Ratio
6.	Account Receivable Turnover
7.	Inventory Turnover
8.	Fixed Asset Turnover
9.	Gross Margin Ratio
10.	Operating Margin Ratio
11.	Return on Sales
12.	Return on Assets
13.	Return on Equity

14.	Dividends to net income
15.	Earnings-per-share
16.	Price earnings ratio
17.	Return on common equity
18.	Capitalization ratio

Table 3. Standardized Financial Statements and Financial Ratios

C. RATIO CATEGORIZATION AND SELECTION

1. Introduction

Ratio analysis consists of relating balance sheet and income statement data to one another to obtain a perspective of the firm's/industry's performance. Ratio analysis for one year is not meaningful. Only when a long term analysis is made does the analysis prove fruitful.

2. Categorization of Financial Ratio

Ratios can be classified into four major categories:

- Profitability
- Activity
- Liquidity
- Leverage

The categories and the ratios used are discussed below.

a. Profitability

Profitability ratios help one measure management's performance in controlling expenses and earning a return on investment or sales. The profits are critical for the firm's survival and success. For that reason, these ratios measure the overall efficiency of the firm and reflect to a degree all of the performance of the firm. [Ref. 15: p. 79]

In this study, the ratios selected were:

- **Gross Margin** = (Net Sales - Cost of Good Sold)/Net Sales
- **Operating Margin** = (Net Sales - Total Cost Expenditures)/Net Sales
- **Return on Sales** = Net Income/Net Sales

- **Return on Assets** = Net Income/Total Assets

b. Activity

Activity is defined as the ratio of output to input. Activity ratios help one to assess how well a firm is managing and controlling its assets and to evaluate the amount of capital necessary to generate sales. When a firm can generate a high level of sales by using few resources, it is regarded as an efficient firm. This usually means the firm is keeping costs down. [Ref. 15: p. 55]

In this study, the ratios selected were:

- **Inventory Turnover** = Net Sales/Inventories
- **Fixed Asset Turnover** = Net Sales/Net Fixed Assets

c. Liquidity

Liquidity ratios measure the firm's ability to meet its current liabilities and short term loans from the bank. Liquidity ratios can relate to: (1) how much liquidity should the firm hold? (2) how the firm manages can its cash most efficiently? (3) ability of the firm to pay bills when they are due. [Ref. 11: p. 58]

In this study, the ratios selected were:

- **Current Ratio** = Current Asset/Current Liabilities
- **Quick Ratio** = (Current Asset - Inventories)/Current Liabilities
- **Accounts Receivable Turnover** = Net Sales/Accounts Receivable

d. Leverage

Leverage ratios measure the degree to which the firm has utilized debt financing in its financial structure. These ratios provide information about the business risk and the financial flexibility of the firm. When the degree of leverage is too large for a firm, the degree of risk that the firm cannot pay interest and debt increases. In general, firms with low leverage have reduced the risk of not being able to meet their cash outflows when the economy is in recession, but, at the same time, they forgo the opportunity of large gains through the use of leverage in periods of upswings. Therefore, the firms have to balance the expected return against increased risk. [Ref. 4: p. 45]

In this study, the ratios selected were:

- **Equity to Debt** = Stockholders' Equity/Total Liabilities
- **Debt Ratio** = Total Debt/Total Liabilities
- **Times Interest Earned** = (Earnings before Taxes plus Interest)/Interest Charges

D. PROCEDURE OF THE ANALYSIS

In this study, the selected financial ratios were examined in order to gain insight into the behavior of the ratios in Taiwan's export industry. For each ratio, the analysis was designed to answer the following two central research questions:

- Has the industry financial condition changed during the appreciation of NT\$ from 1986 ~ 1993?
- Was the stability of the financial condition of the export industry related to the stability of the NT\$? More specifically, was the financial condition of the export industry more stable during the 1990-1993 period than during the 1986-1989?

1. Financial Condition 1986 ~ 1993

The first phase of the analysis will evaluate the financial condition of Taiwan's export industry from 1986 to 1993. The financial condition will be evaluated by testing the financial ratios of Taiwan's export industry. The financial condition of the export industry will be measured by the mean of the ratio values for the sample firms for each year.

Two approaches will be used to test the ratio values (1) plot the mean ratio, and (2) statistical tests of differences in the mean ratio. Those two methods are used to answer the following question:

- Has the industry condition changed during the appreciation of NT\$?
- If the industry condition has changed, is the change significant?

a. Mean Plot

A plot of mean values of the annual financial ratios will be used to display the general level of ratio values and fluctuations in those values over time. The plot of the mean values will reflect the overall trend for Taiwan's export industry. An upward trend of the financial ratios would indicate improvement in the financial condition, but a downward trend of the financial ratios would indicate deterioration of financial condition.

b. Statistical Test

A statistical test will be used to compare the means of each year's financial ratio values. The null hypothesis for the test is stated "as all the means of each year's financial ratio values are equal".

$$\begin{aligned} H_0 : \mu_{86} &= \mu_{87} = \mu_{88} = \mu_{89} = \mu_{90} = \mu_{91} = \mu_{92} = \mu_{93} \\ H_1 : \mu_{86} &\neq \mu_{87} \neq \mu_{88} \neq \mu_{89} \neq \mu_{90} \neq \mu_{91} \neq \mu_{92} \neq \mu_{93} \end{aligned} \quad (4)$$

The statistical test to be used is single-factor ANOVA. This statistical test is based on three assumptions:

- The observations must be randomly selected.
- The populations from which the observations are taken must all be normally distributed.
- The variables in each group must come from the populations.

By conducting a test of whether or not the treatment means are equal, then the risk of concluding H_1 is to be controlled at α , when H_0 is true. A decision can be made by comparing the p-value and the α risk. [Ref. 14: p. 330]

- If p-value $> \alpha$ risk, then conclude H_0 .
- If p-value $< \alpha$ risk, then reject H_0 .

The other decision rule is based on the F test. A large value of F leads to concluding H_1 holds. The decision rule for the F test is:

- If F test result \leq F value, conclude H_0 .
- If F test result $>$ F value, then reject H_0 . [Ref. 14: p. 662]

2. Stability of the Financial Condition

The exchange rate of Taiwan' dollar to US dollars was 40: 1 in 1985, but due to accumulating too much foreign currency reserves, the value of Taiwan Dollar began to appreciate in 1986 and stabilized at the exchange rate 26:1 in 1990. Due to exports comprising a major part of the country's economy, government considered the NT\$ appreciation too drastic, which would reduce the earnings of the export industry too much and not permit enough time for the industry to modernize and improve facilities to upgrade

industrial technology and reduce production cost in the future. So the NT\$ was allowed to appreciate only mildly from 1986 to 1990. This policy permitted the industries to have time to adjust their operations. By the time the new policy took effect, the NT\$ appreciated about 60% when exchange rates stabilized in 1990-1993 compare to the NT\$ in 1986. Two methods are used to answer the following question: Was the stability of the financial condition of the export industry related to the stability of the NT\$? More specifically, was the financial condition of the export industry more stable during the 1990-1993 period than during the 1986-1989 period?

a. *The Mean of Absolute Value of First Annual Difference Plots*

A plot of the means of absolute value of first annual difference in financial ratios displays the overall trend of change (instability) in the export industry. If the appreciation affected the stability of the export industry, the mean of the absolute value of first differences in annual financial ratios would show an increasing trend. If the export industries returned to a stable condition, the mean of absolute value of first differences of financial ratios would show a decrease.

b. *Statistical Test*

A statistical test will be used to compare the stability of financial ratio values during the period when NT\$ appreciated with the financial ratio values during the period after NT\$ stabilized.

A T-test will be used to answer the question of whether there is a significant difference between the means of two distinct populations. A T-test is used to answer whether one group of data is inherently different from another owing to some influences; or whether apparent differences should be attributed to sampling variation. [Ref 14, p 337]

A T-test is used to test whether there is a significant difference between the stability of financial ratios during NT\$ appreciation (1986-1989) compared to when the exchange rate stabilized (1990-1993). In this test, the measures from 1986, 1987, 1988 and 1989 form one group, and the measures from 1990, 1991, 1992 and 1993 form another group. The null hypothesis is stated as there is not any significant difference between the means of two groups.

$$\begin{aligned} H_0 : \mu_{86-89} &= \mu_{90-93} \\ H_1 : \mu_{86-89} &\neq \mu_{90-93} \end{aligned} \tag{5}$$

By conducting a test of whether or not the treatment means are equal, then the risk of concluding H_1 is controlled at α , when H_0 is true. A decision can be made by comparing the p -value and the α risk. [Ref. 14: p. 330]

- If p -value $> \alpha$ risk, then conclude H_0 .
- If p -value $< \alpha$ risk, then reject H_0 .

The other decision rule for a test involves a t . A large value for t leads to concluding H_1 . A small value for t leads to concluding H_0 . The decision rule for T-test results is:

- If $|t^*| \leq t$ -value, conclude H_0 .
- If $|t^*| > t$ -value test, then reject H_0 . [Ref. 14: p. 662]

IV. PROFITABILITY

A. INTRODUCTION

Profitability ratios help one judge management's performance in controlling expenses and earning a return on the resources committed to the business. In this study four representative ratios are evaluated in order to gain insight into the profitability situation of Taiwan's export industry for the period of a 1986-1993.

B. GROSS MARGIN

The gross margin ratio shows the relative profitability after the cost of goods sold has been deducted from sales. This ratio indicates the operating efficiency in terms of production as well as the efficient pricing of the firm's products. In a going business, gross margins must be maintained sufficiently high to cover expenses and to provide a satisfactory profit. The gross margin ratio is calculated follows:

- $\text{Gross Margin} = (\text{Net Sales} - \text{Cost of Goods Sold}) / \text{Net Sales}$

Gross profit varies widely between industries and lines of business. In a highly competitive environment, A gross margin ratio tends to become lower. An unacceptably low margin means that on an overall basis too much is being paid for merchandise, or selling prices are too low, or both. [Ref. 5: p. 26]

1. Industry Condition

The means of the gross margin ratio of the export industry are calculated and plotted in Figure 1. The plot shows the ratio deteriorating from 1986 to 1989 and stabilizing during 1990-1993 while the gross margin decreased from 25% in 1986 to 15% in 1993. It seems the industry condition has been changed by the NT\$ appreciation. Was the change of the industry condition is significant or not? The ANOVA was used to answer this question. The oneway ANOVA (1986-1993) test was used to compare the means of each year's ratio level.

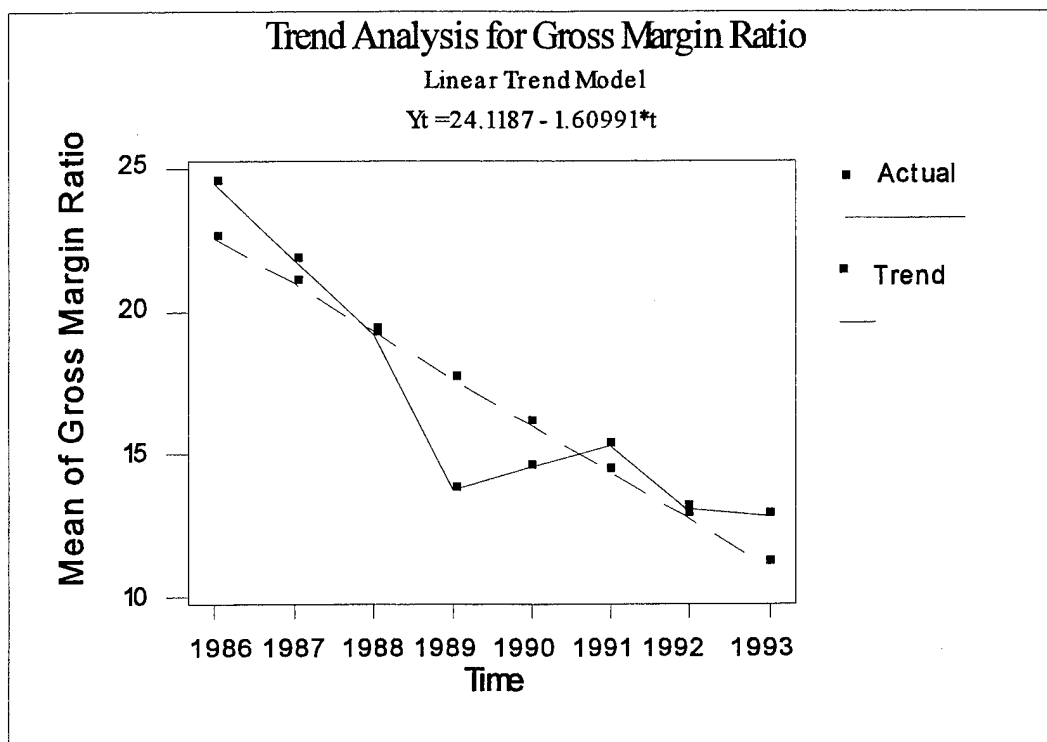


Figure 1. Gross Margin Ratio of the Export Industry

The ANOVA (1986-1993) of Table 4 shows that the F-value is very large and the p-value is less than 0,001. The test result shows that the null hypothesis is rejected at a 95% confidence level and it is concluded that there is significant change in the industry condition due to NT\$ appreciation.

Gross	Margin	Test	Value
Ratio	ANOVA	F*	4.61
		P	0.0001
	T	t*	4.05
Level	Test	P	0.0001

Table 4. ANOVA Gross Margin Ratio (1986-1993)

2. Stability

F-test shows that the industry condition has changed since NT\$ appreciated. Did the industry condition stabilize during the period when NT\$ appreciated slowly? The mean of absolute value of first annual difference of financial ratio displays the overall trends of change (instability) in the export industry. The mean of absolute first annual difference of the gross margin ratio was calculated and is plotted in Figure 2. The plot shows the industry unstable from 1986 to 1990 and return to normal from 1990. Visually, Figure 2 shows the export industry more stable during the 1990-1993 period than during 1986-1989 period.

A t-test was used to test whether or not the instability levels changed significantly from 1986 to 1993. The test result is listed in Table 4. The t-value is very large and the p-value is less than 0.001. The result from the t-test rejects the null hypothesis of equality of the stability levels of 1986-1989 and 1990-1993, at a 95% confidence level.

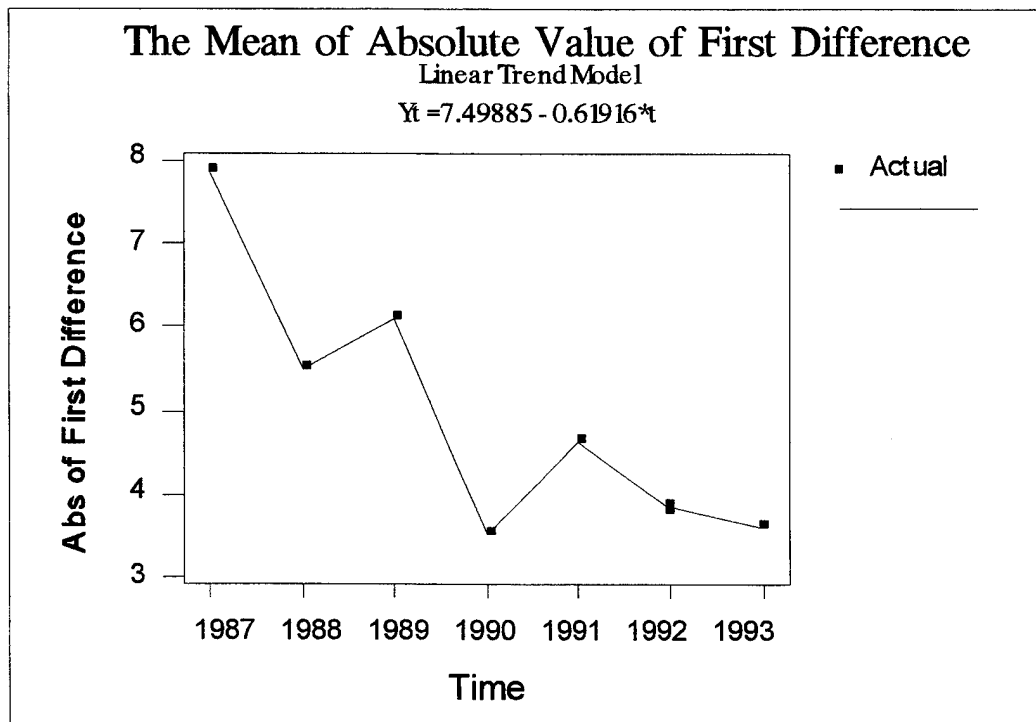


Figure 2. Difference of the Gross Margin Ratio

3. Summary

Taiwan export industry experienced deteriorating gross margins due to the exchange rate appreciation. The visual analysis and statistical tests showed the deterioration in the ratio values. Those analyses show that the industry condition changed a lot and the industry faces a more competitive environment due to the exchange rate appreciation.

A statistical test showed the gross margin ratio of export industry unstable from 1986 to 1993. But visually analysis of the plot of means of absolute first annual differences showed that the industry returned to a more stable condition after 1990.

C. OPERATING MARGIN

The amount of the operating income, which is one of the most important figures shown on the income statement, reveals the profitability of sales. The operating income can be related to the net sales by computing the ratio of operating income to net sales. The operating margin ratio is calculated as follows:

- $\text{Operating Margin} = (\text{Net Sales} - \text{Total Cost Expenditures}) / \text{Net Sales}$

This ratio provides a measure of operating income dollars generated by each dollar of sales. While it is desirable for this ratio to be high, changing environmental conditions may cause the operating margin ratio to vary over some time period. [Ref. 5: p. 29]

1. Export Industry Condition

The means of the operating margin ratio of the export industry are calculated and plotted in Figure 3. The plot shows the operating margin ratio decreasing from 18% in 1987 to 14% in 1993. It seems the export industry has been changed by the NT\$ appreciation. Was the change of the industry condition is significant or not? The oneway ANOVA test was used to answer this question. The results of the test are listed in the Table 5.

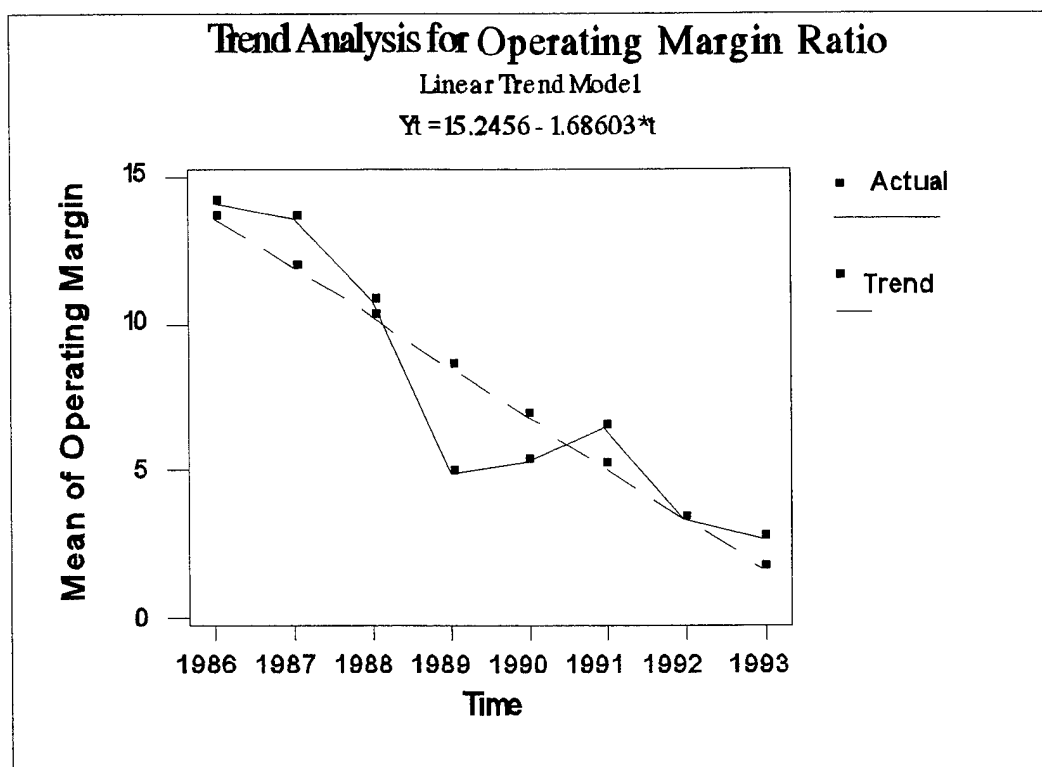


Figure 3. Operating Margin Ratio of the Export Industry

Operating	Margin	Test	Value
Ratio	ANOVA	F*	9.84
		P	0.0001
	T	t*	6.08
Level	Test	P	0.0001

Table 5. ANOVA Operating Margin (1986-1993)

The oneway ANOVA test was used to compare the means of each year's ratio values. Because the F-value is 9.84 and the P-value less than 0.001, the null hypothesis is rejected at a 95% confidence level and we can conclude that the export industry operating margin ratios have been impacted by the NT\$ appreciation.

2. Stability

F-test shows that the industry condition has changed since the NT\$ appreciation. Did the industry condition stabilize during the period when NT\$ appreciated? The mean of absolute value of first annual difference financial ratio displays the overall trends of change (instability) in the export industry. The mean of absolute first annual differences of the operating margin ratio was calculated and is plotted in Figure 4. The plot shows the industry unstable from 1987 to 1990 and becoming more stable after 1990, which means the export industry instability during 1986-1990 was related to the NT\$ appreciation.

A t-test was used to test whether or not the instability levels of the export industry changed significantly from 1986 to 1993. The test result is listed in Table 5. The t-value of 9.84 is very high and the p-value is less than 0.0001. The t-test result rejects the null hypothesis of equality of the stability levels of 1986-1989 and 1990-1993.

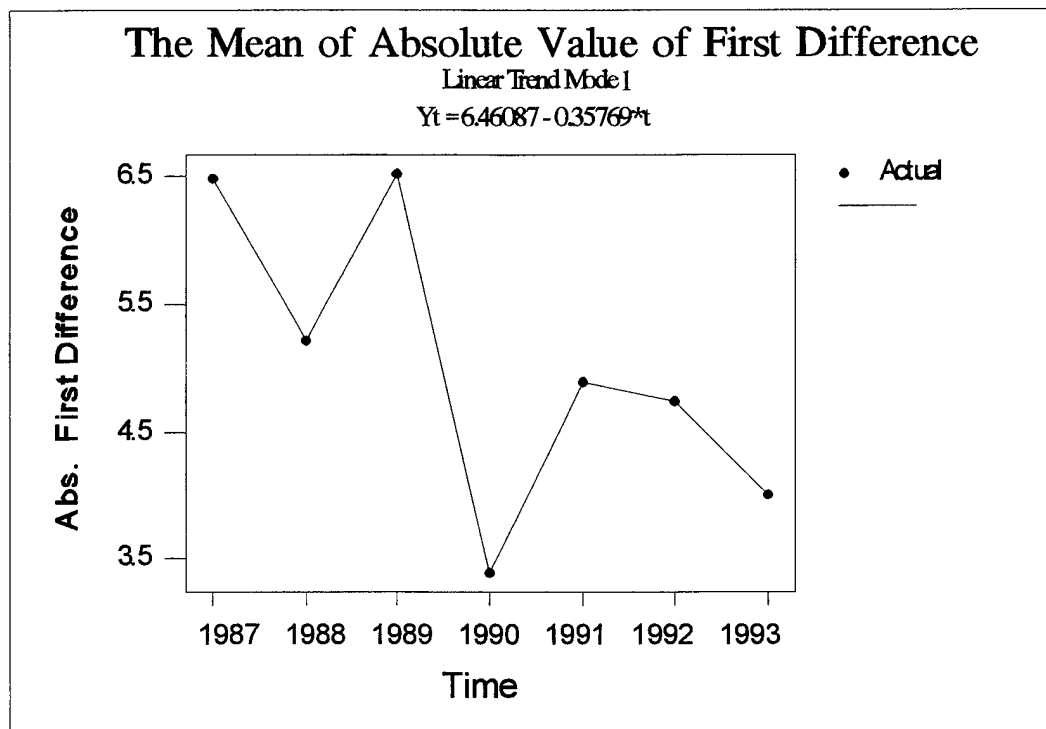


Figure 4. Differences of the Operating Margin Ratio

3. Summary

The operating margin of Taiwan's export industry showed a declining condition which means the industry was impacted by the NT\$ appreciation. The operating income dollars generated by each dollar of sales decreased from 18% in 1986 to 14% in 1993.

A statistical test showed the operating margin ratio of export industry unstable from 1986 to 1993. But visually, the plot of mean of absolute first annual difference of the operating margin ratios showed the industry returned to a more stable condition after 1990.

D. RETURN ON ASSETS

The rate of return on assets ratio provides insight into the profitability of the total resources committed to the business. The return on asset ratio indicates how successful a management is putting its assets to work in making profits, and measures the earning power of the firm's investment in assets. The return on assets is calculated as followed:

- $\text{Return on Assets} = \text{Net Income} / \text{Total Assets}$

It should be noted that in this ratio is determined by the profit earned on each dollar of sales and the efficiency of asset management. [Ref. 15: p. 69]

1. The Export Industry Condition

The means of the return on assets ratios are calculated and plotted in Figure 5 to display the trend of the ratio during the period of 1986-1993. The plot indicates there was deterioration in the export industry. Visually, the plot of return on assets ratios shows the ratio decreasing from 15% in 1986 to 6% after 1990. In order to test if the industry condition differed year-to-year significantly or not, the oneway ANOVA test was used. The results of the test are listed in the Table 6.

The oneway ANOVA test of 95% confidence level showed that the F-value is 16.04 and P-value is less than 0.001. The F-value is very high and the null hypothesis is readily rejected. This provides strong evidence that the ratio of return on assets experienced a significant change in the export industry during 1986-1993.

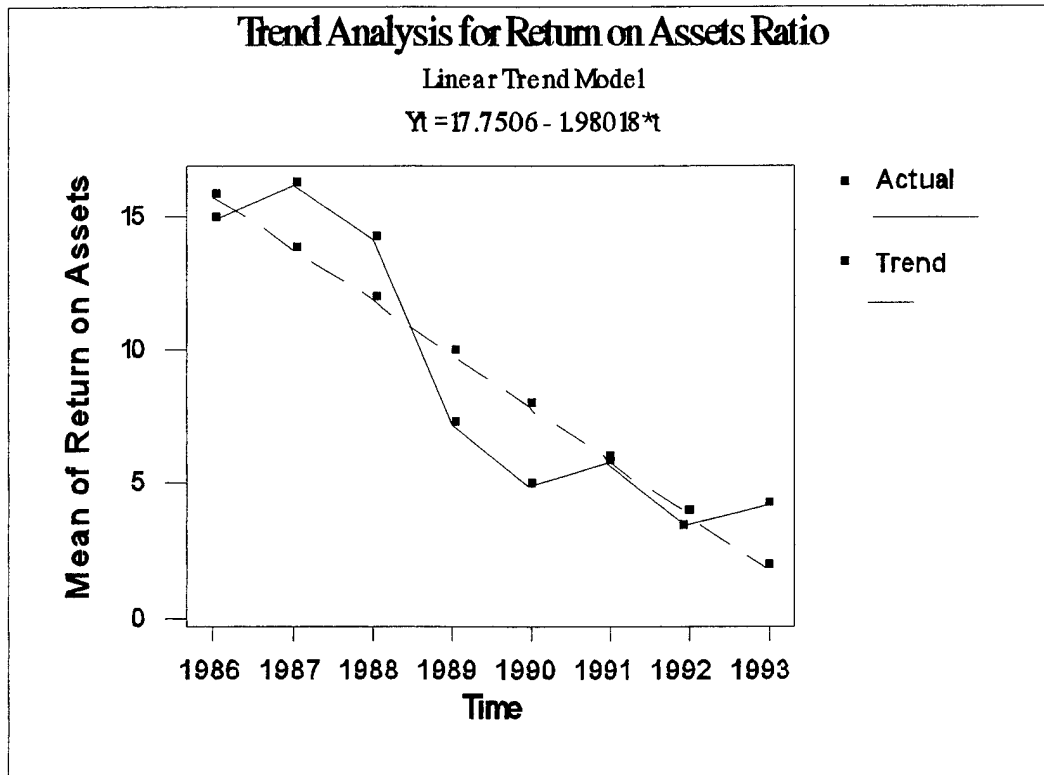


Figure 5. Return on Assets Ratios

Return on Assets		Test Value	
Ratio	ANOVA	F*	16.04
		P	0.0001
	T	t*	8.02
		P	0.0001

Table 6. ANOVA Return On Assets

2. Stability

Visually, Figure 5 and the F-test show that the industry condition has changed since the NT\$ appreciation. Did the industry condition stabilize during the period when NT\$ appreciated? The means of the absolute value of first annual differences of the return on assets ratio displays the overall trend of change (instability) in the export industry. The means of absolute first annual difference of the return on assets ratio was calculated and is plotted in Figure 6. The plot shows the industry unstable between 1987 and 1989.

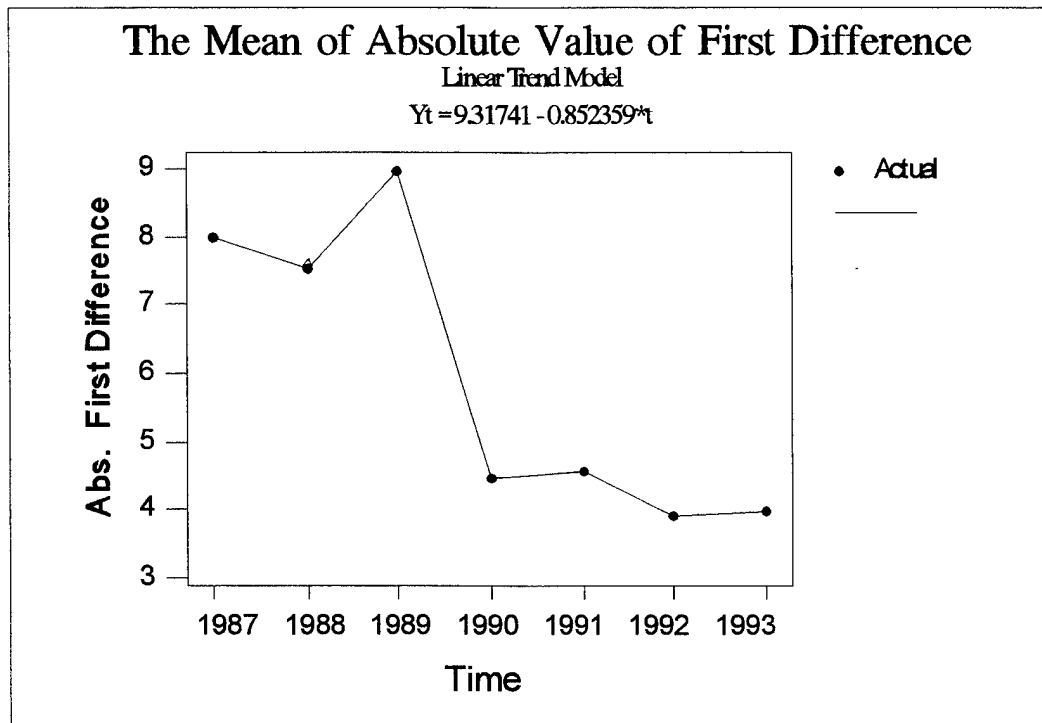


Figure 6. Difference of the Return on Assets Ratio (1987-1993)

A t-test was used to test whether or not instability levels changed significantly during the NT\$ appreciation. The test result is listed in Table 6. Because the 95% confidence level of t-test value is 8.82 and the P-value is less than 0.01, one can reject the null hypothesis of equality of the stability levels of 1986-1989 and 1990-1993 at a 95% confidence level.

3. Summary

The return on assets ratios of Taiwan's export industry showed a declining condition of the earning power of the industry's investment in assets, which means the industry was impacted by the NT\$ appreciation. Visually, the plot of the means of the ratio shows the profitability of the total resources committed to the business declining after 1990 to only 6%.

A statistical test showed the return on assets ratios of the export industry unstable between 1986-1989. Visually the plot of means of the absolute first annual differences of the return on assets ratio showed the industry unstable between 1987 and 1989. The unstable condition related to the NT\$ appreciation, but the condition stabilized after 1990.

E. RETURN ON SALES

The return on sales ratio measures, relative to sales, the difference between what a company takes in and what it spends in conducting its business. The return on sales is calculated as followed:

- **Return on Sales** = Net Income/Net Sales

A high value usually goes hand-in-hand with long-term business success. High returns provide capital for growth as well as protection against unexpected economic downturns. The most likely cause for an unsatisfactorily low return is an insufficient gross margin. Another possibility is that expenses are too high relative to sales. Conversely, high returns are common for firms offering proprietary products, or possessing some form of competitive edges. [Ref. 5: p. 35]

1. The Export Industry Condition

The means of the return on sales ratios are calculated and plotted in Figure 7 to display the trend of the ratio during the period of 1986-1993. The plot indicates there was a lot of deterioration in the export industry. Visually, the plot showed there was about 12% return on sales ratio before 1989 but after 1990 the ratio only about 2%-4%. In order to test if the industry condition differed year-to-year significantly or not, the oneway ANOVA test was used. The results of the test are listed in the Table 7.

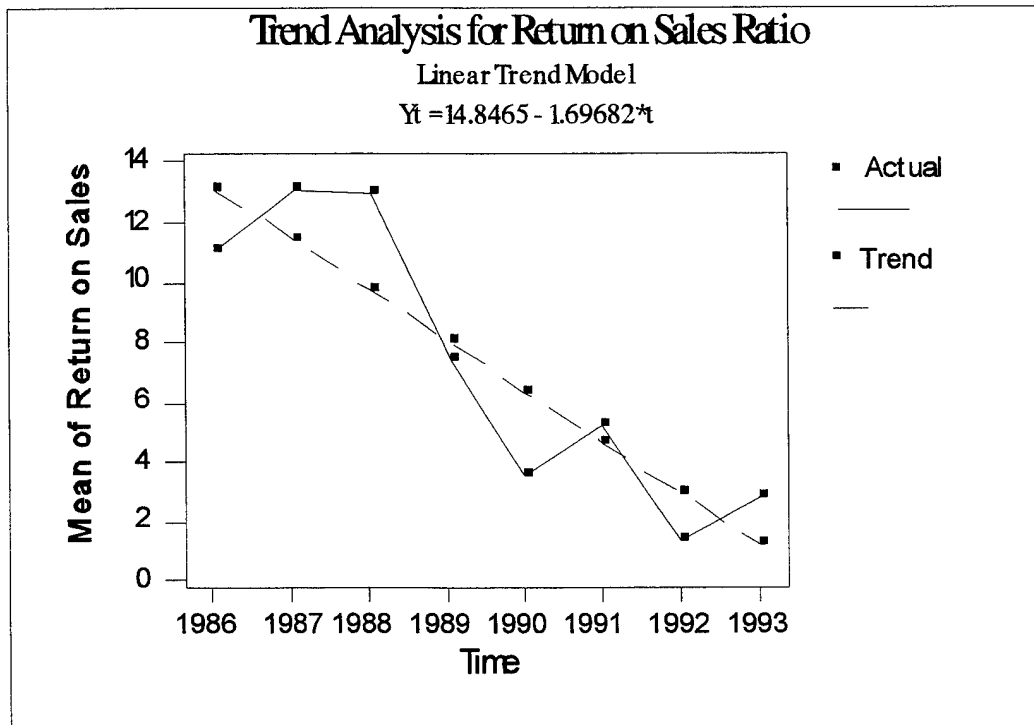


Figure 7. Return on Sales Ratios

The oneway ANOVA test of 95% confidence level showed that the F-value is 9.16 and P-value is less than 0.001. The F-value is quite high, and the null hypothesis is readily rejected. This provides strong evidence that the ratio of return on sales significantly changed in the export industry condition during 1986-1993.

Return on Sales		Test	Value
Ratio	ANOVA (1986-1993)	F*	9.16
		P	0.0001
Level	T Test	t*	7.17
		P	0.0001

Table 7. ANOVA Return on Sales

2. Stability

Visually, Figure 7 and the F-test show that the industry condition has changed since the NT\$ appreciation. Did the industry condition stabilize during the period when NT\$ appreciated? The means of the absolute value of first annual differences of the return on sales ratio displays the overall trend of change (instability) in the export industry. The means of absolute first annual differences of the return on sales ratio was calculated and plotted in Figure 8. The plot showed the financial condition of the export industry unstable between 1988 and 1991, which may be related to the stability of the NT\$. The financial condition stabilized after 1991.

A t-test was used to test whether or not the ratio of instability levels changed significantly during the NT\$ appreciation. The test results are listed in Table 7. The 95% confidence level of t-test value is 7.17 and the P-value is less than 0.01. Since the t-value is very high, one can reject the null hypothesis of equality of the stability levels of 1986-1989 and 1990-1993 at a 95% confidence level.

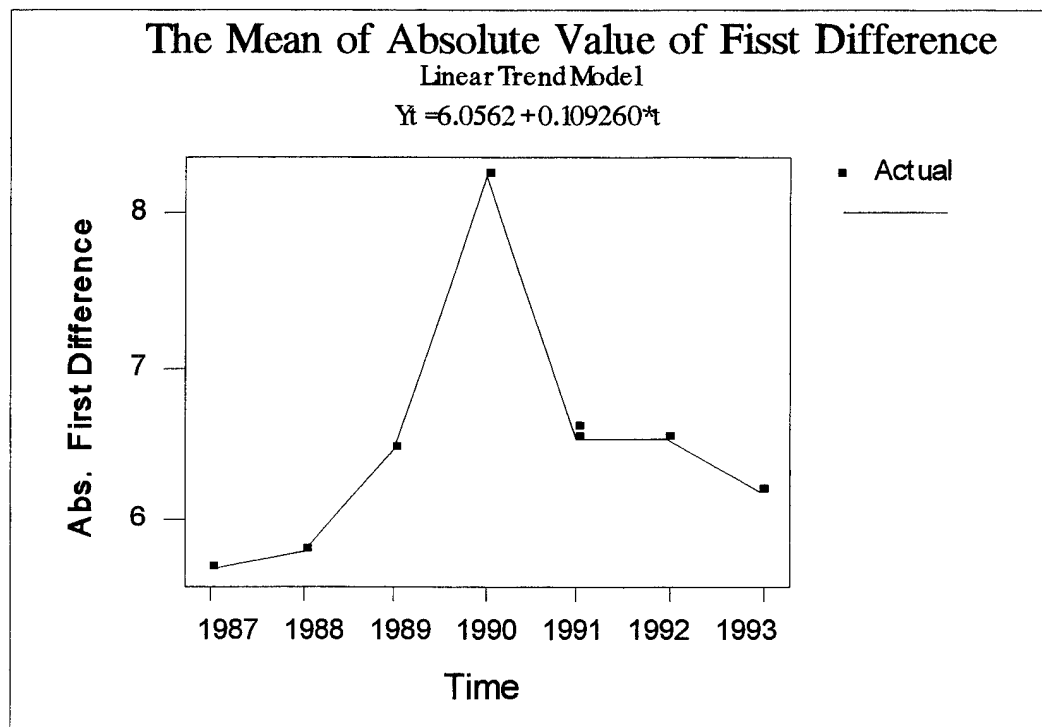


Figure 8. Differences of the Return on Sales

3. Summary

The return on sales of Taiwan's export industry showed a declining condition, which means the industry was impacted by the NT\$ appreciation. Visually, Figure 7 shows the return on sales ratios only about 2%-4% after 1990, lower than the 12% before 1988. The most likely reason for the low return is insufficient gross margins after 1990, indicating the ratio was impacted by the exchange rate appreciation.

Visually, the plot of means of absolute first annual differences showed the industry unstable between 1989 and 1991. The unstable condition may be related to the NT\$ appreciation, but the condition stabilized after 1990.

F. SUMMARY PROFITABILITY RATIO

The four representative ratios show that the ability of Taiwan's export industry to earn a return on the resources committed to the business decreased, but stabilized after 1990. The industry faces a more competitive environment due to the exchange rate appreciation.

V. ACTIVITY

A. INTRODUCTION

Activity ratios, also known as efficiency or turnover ratios, help one to judge how well a firm is managing and controlling its assets. Activity ratios also help one to assess if a firm is controlling its assets and to evaluate the amount of capital necessary to generate sales. Activity ratios of Taiwan's export industry assist the analyst in evaluating the amount of capital necessary to generate sales and evaluating how well the industry is keeping costs down.

B. INVENTORY TURNOVER

The inventory turnover ratio provides insight into how well inventory is managed and controlled. More specifically, the ratio helps one to judge if a change in inventory is due to sales or to some other factor such as a slowdown in the time it takes on average for a firm to produce and/or to sell its inventory. [Ref. 15: p. 63] The inventory turnover ratio is calculated as follows:

- **Inventory Turnover** = Net Sales/Inventories

A low inventory turnover may reflect dull business; overinvestment in inventory. A high turnover of inventory may not be accompanied by a relatively high net income, since profits may be sacrificed in obtaining a larger sales volume. A higher rate of turnover of inventory is likely to prove less profitable than a lower turnover unless accompanied by a larger total gross margin, although the rate of gross margin may well be the same or even slightly lower. [Ref. 7: p. 320]

1. Export Industry Condition

The means of the inventory turnover ratio of the export industry are calculated and plotted in Figure 9. The plot shows the ratio deteriorating a little from 1986 to 1990 and increasing after 1990. But the ratio in 1993 was only about 1% lower when compared to the ratio in 1986. It seems the industry condition did not change a lot.

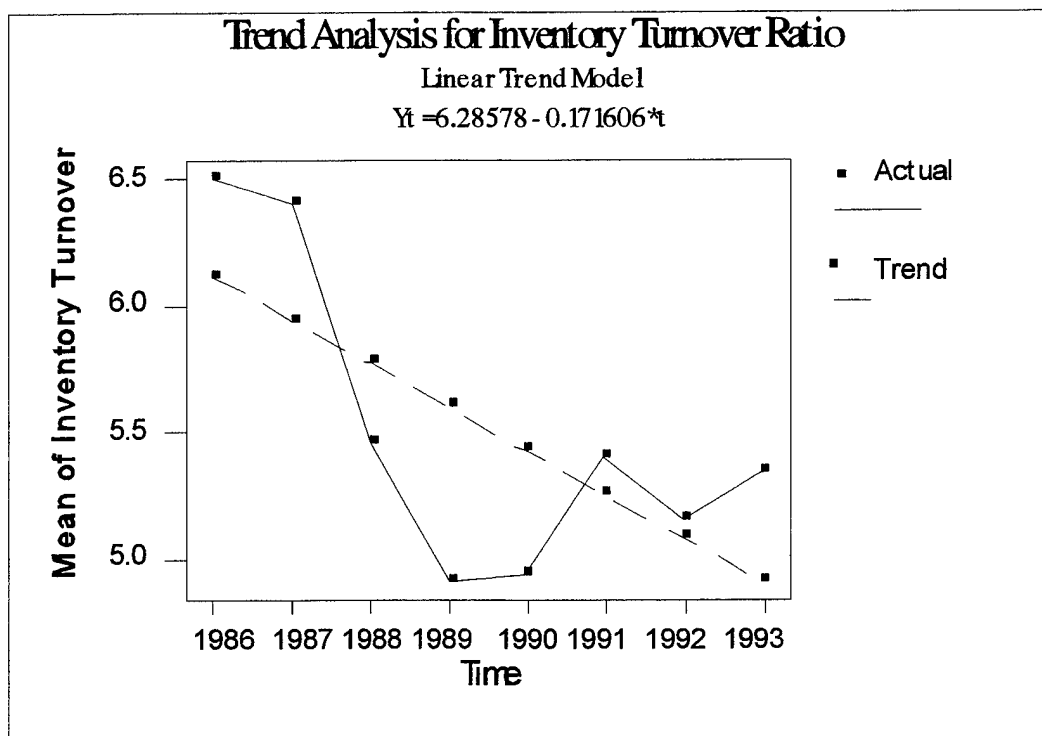


Figure 9. Inventory Turnover Ratio of the Export Industry

Was the change of the industry condition significant or not? The oneway ANOVA(1986-1993) test was used to compare the means of each year's ratio level. The test result is listed in Table 8. The oneway ANOVA test of 95% confidence level showed that the F-value is 1.94 and P-value is 0.063. The null hypothesis of no difference is accepted and it is concluded that year-to-year changes in the inventory turnover ratio are not significant.

Inventory	Turnover	Test	Value
Ratio Level	ANOVA (1986-1993)	F*	1.94
		P	0.063
	T Test	t*	1.94
		P	0.053

Table 8. ANOVA Inventory Turnover

2. Stability

The F-test shows that the industry condition did not change much due to the NT\$ appreciation. Was the industry condition stable during the period when NT\$ appreciated? The means of the absolute value of first annual differences of the inventory turnover ratio display the overall trend of change (instability) in the export industry.

The means of absolute first annual differences of the inventory turnover ratio were calculated and are plotted in Figure 10. The plot shows the industry instable from 1987 to 1988 with return to stability after 1989. Visually, Figure 10 showed the export industry more stable during the 1990-1993 period than during 1986-1989 period.

A t-test was used to test whether or not the instability levels changed significantly from 1986 to 1993. The test result is listed in Table 8. Because the t-value is 1.94 and the P-value is 0.053, one can accept the null hypothesis of no difference of 1986-1989 and 1990-1993, at a 95% confidence level.

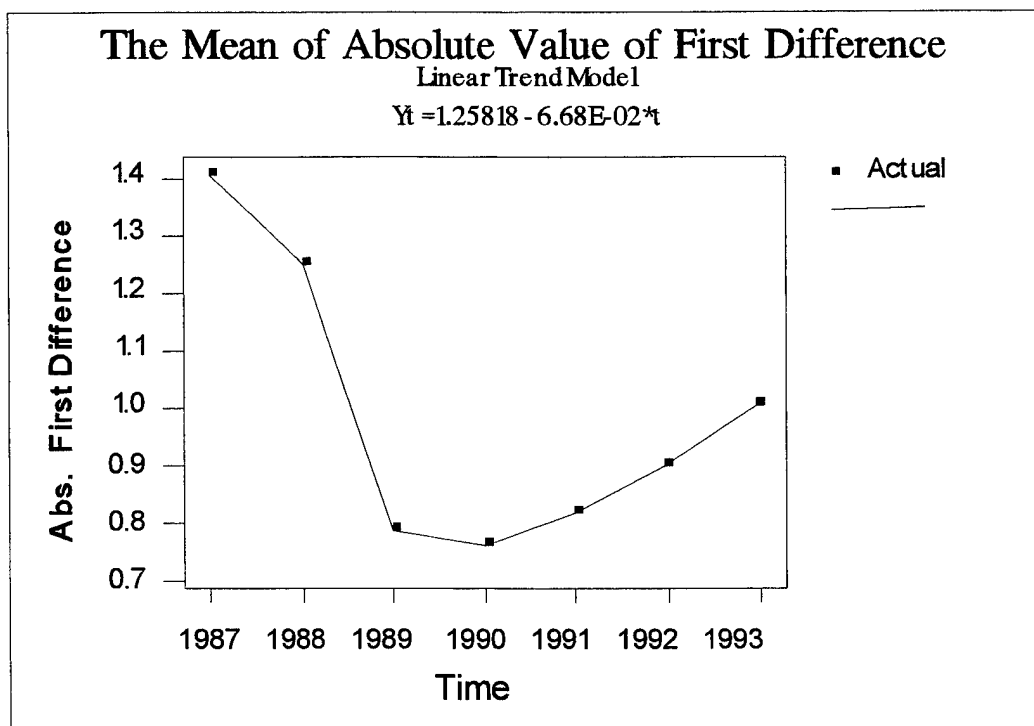


Figure 10. Differences of the Inventory Turnover Ratio

3. Summary

The visual analysis and statistical tests showed the inventory turnover ratio was not affected much by the NT\$ appreciation.

Visually, the plot of means of absolute first annual differences showed the industry condition instable from 1987 to 1989. But t-test showed the inventory turnover ratio equally stable during the period 1990-1993 and the period 1986-1989.

C. FIXED ASSET TURNOVER

The fixed asset turnover ratio aids one in appraising capacity utilization and the quality of fixed assets. This ratio measures the turnover of plant and equipment owned by the firm and evaluates whether the firm (1) does or does not have much plant and equipment on hand for the existing sales level, or (2) whether it is just using the existing plant and equipment inefficiently. [Ref. 4: p. 50] The fixed asset turnover ratio is calculated as follows:

- **Fixed Asset Turnover** = Net Sales/Net Fixed Assets

A decrease in the ratio may result from reduced sales or inefficient use of fixed assets. As long as the ratio shows an increasing trend, it can be concluded that the efficiency in plant capacity utilization is improving. A declining fixed asset turnover ratio might be a sign of excess capacity, while an abnormally high turnover might indicate that the firm is relying on old plant and equipment. [Ref. 15: p. 58]

1. Export Industry Condition

The means of the fixed assets turnover ratio of the export industry were calculated and plotted in Figure 11. The plot shows the ratio deteriorated from 1986 to 1989 and stabilized after 1990. But the ratio in 1993 is only about 1% lower when compared to the ratio in 1986. It seems the industry condition did not change a lot. In order to test if the industry conditions differ year-to-year significantly or not, the oneway ANOVA test was used. The oneway ANOVA(1986-1993) test was used to compare the means of each year's ratio level. The test result is listed in Table 9. The oneway ANOVA test of 95% confidence level showed that the F-value is high and P-value is 0.01. Then the null hypothesis of no difference is rejected and it is concluded that year-to-year changes in the fixed assets turnover ratio are significant.

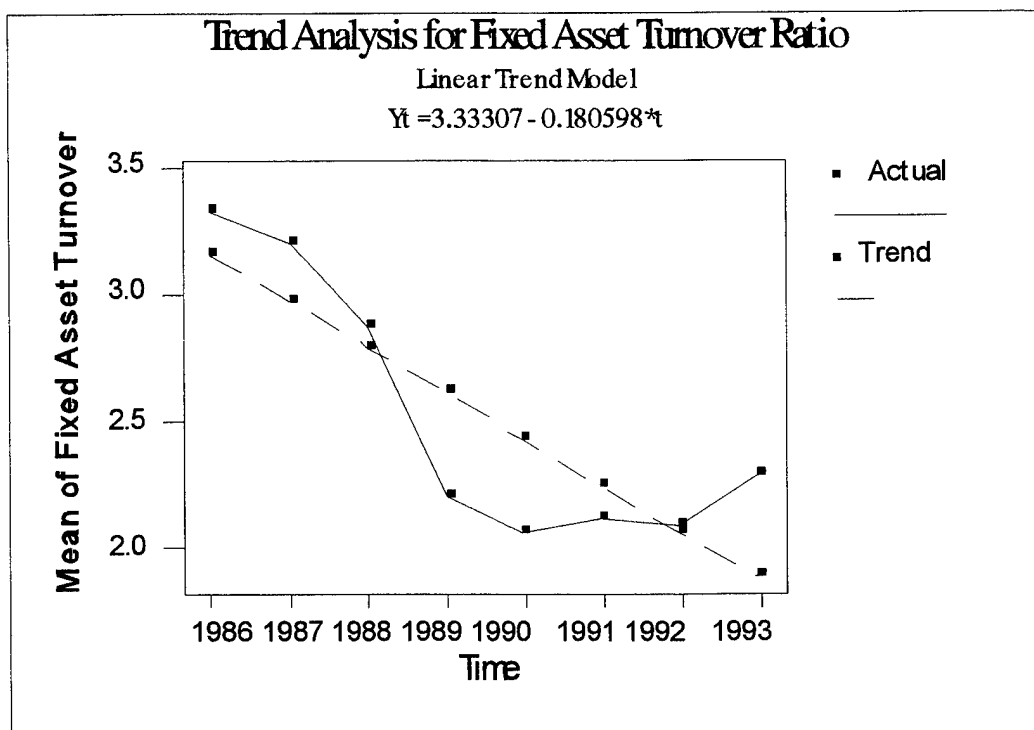


Figure 11. Fixed Assets Turnover Ratio of the Export Industry

Fixed	Asset Turnover	Test	Value
Ratio	ANOVA (1986-1993)	F*	2.7
		P	0.01
Level	T Test	t*	3.63
		P	0.0003

Table 9. ANOVA Fixed Asset Turnover

2. Stability

The F-test shows that the industry condition has changed because the NT\$ appreciated. Was the industry condition stable during the period when NT\$ appreciated?

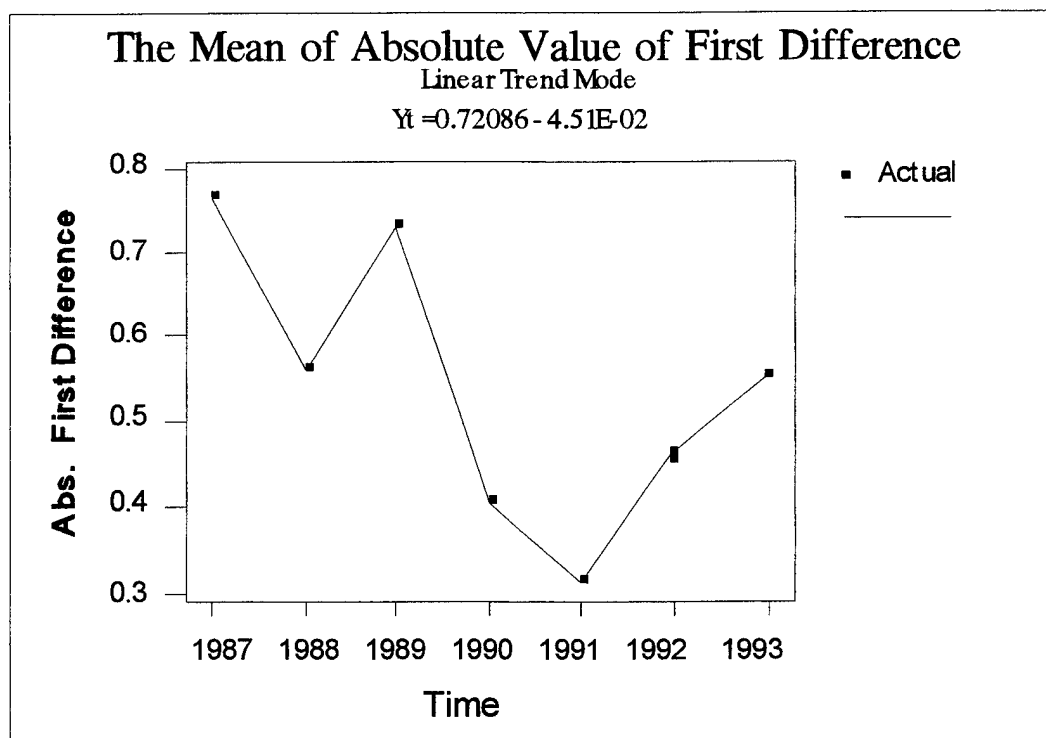


Figure 12. Differences of the Fixed Assets Turnover Ratios

The means of the absolute value of first annual differences of the fixed assets turnover ratio display the overall trend of change in the export industry. The means of absolute first annual differences of the fixed assets turnover ratios were calculated and are plotted in Figure 13. The plot shows the industry unstable from 1987 to 1989 with a return to normal after 1990. Visually, the Figure 13 showed the export industry financial condition more unstable during the 1986-1989 period than during 1990-1993 period.

A t-test was used to test whether or not the instability levels changed significantly from 1986 to 1993. The test result is listed in Table 9. The t-value is very large and the p-value is less than 0,001. The result from the t-test rejects the null hypothesis of equality of the stability levels of 1986-1989 and 1990-1993, at a 95% confidence level.

3. Summary

Taiwan's export industry experienced deteriorating fixed assets turnover ratios due to the exchange rate appreciation. The visual analysis and statistical tests showed the

deterioration in the ratio values. The industry condition decreasing may result from reduced sales or inefficient use of fixed assets, which means the industry may have been impacted by the NT\$ appreciation.

A statistical test showed the fixed assets turnover ratio of export industry more unstable during 1986 to 1989. But visual the plot of the means of absolute first annual differences of the fixed assets turnover ratio showed the industry return to normal condition after 1991.

D. SUMMARY FOR ACTIVITY RATIO

The inventory turnover ratio shows the export industry decreasing in inventory turnover, which may reflect dull business. The fixed assets turnover ratio experienced deterioration due to the exchange rate appreciation. The industry decreasing in fixed assets turnover may result from reduced sales or inefficient use of fixed assets, which means the industry was impacted by the NT\$ appreciation.

VI. LIQUIDITY

A. INTRODUCTION

Liquidity ratios measure the firm's ability to meet its current liabilities and short term loans from the bank. Liquidity ratios can quickly point out: (1) how much liquidity should the firm hold? (2) how can the firm manage its cash most efficiently? (3) what ability the firm will have the cash to pay bills when they are due. [Ref. 11: p. 58]

B. CURRENT RATIO

The current ratio is sometimes called the working capital ratio. The current ratio indicates the degree of safety with which short-term credit may be extended to the business by current creditors. The current ratio measures to some extent the liquidity of the assets and the ability of a business to meet its maturing current obligations.

The current ratio is calculated as follows:

- **Current Ratio** = Current Assets/Current Liabilities

A current ratio of 200 percent, i.e., a ratio of \$2 of current assets to \$1 of current liabilities, is sometimes considered to be satisfactory. A satisfactory current ratio for a commercial or industrial company indicates it can pay its current debts on time. Much higher ratios could mean that management is not aggressive in finding ways to put current assets to work. [Ref. 7: p. 308]

1. Export Industry Condition

The means of the current ratio of the export industry are calculated and plotted in Figure 13 to display the trend of the ratio during the period of 1986-1993. The plot shows the ratio increasing from 150% in 1986 to 220% in 1990, then decreasing a little to 200% in 1993. It seems the export industry has been changed by the NT\$ appreciation. In order to test if the industry condition differed year-to-year significantly or not, the oneway ANOVA test was used. The oneway ANOVA (1986-1993) test was used to compare the means of each year's ratio level. The test result is listed in Table 10.

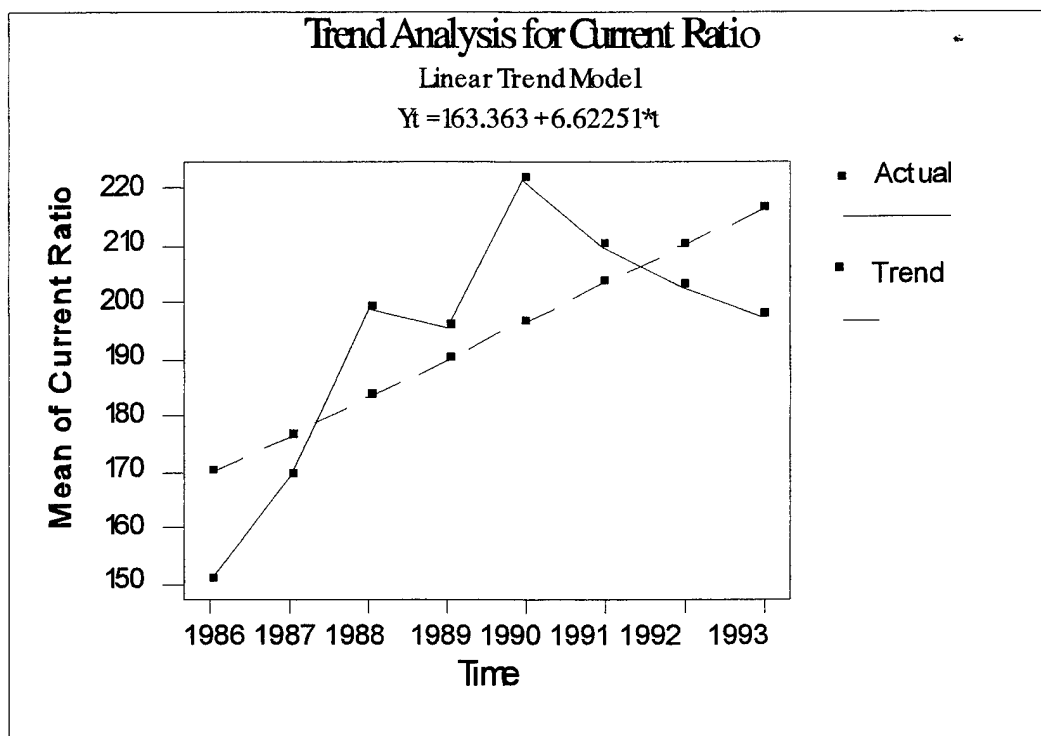


Figure 13. Current Ratio of the Export Industry

Current Ratio		Test Value	
Ratio	ANOVA (1986-1993)	F*	1.23
		P	0.283
	T	t*	-2.14
Level	Test	P	0.033

Table 10. ANOVA Current Ratio

The oneway ANOVA (1986-1993) test showed that the F-value is 1.23 and P-value is 0.283. The test result shows that the null hypothesis of no difference is accepted and it is concluded that there is no significant change in the current ratio due to NT\$ appreciation.

2. Stability

The F-test shows that the current ratio of export industry did not change much. Was the industry condition stable during the period when the NT\$ appreciated? The means of absolute value of the first annual differences of the current ratio display the overall trend of change in the export industry.

The means of absolute first annual differences of the current ratio were calculated and are plotted in Figure 14. Visually, Figure 14 showed the export industry unstable during 1990-1992 period.

A t-test was used to test whether or not the instability levels changed significantly from 1986 to 1993. The test result is listed in Table 10. Since the t-value is -2.14 and the P-value is 0.033, which is beyond 95% confidence level, one can conclude the null hypothesis of equality of the stability levels of 1986-1989 and 1990-1993 is rejected.

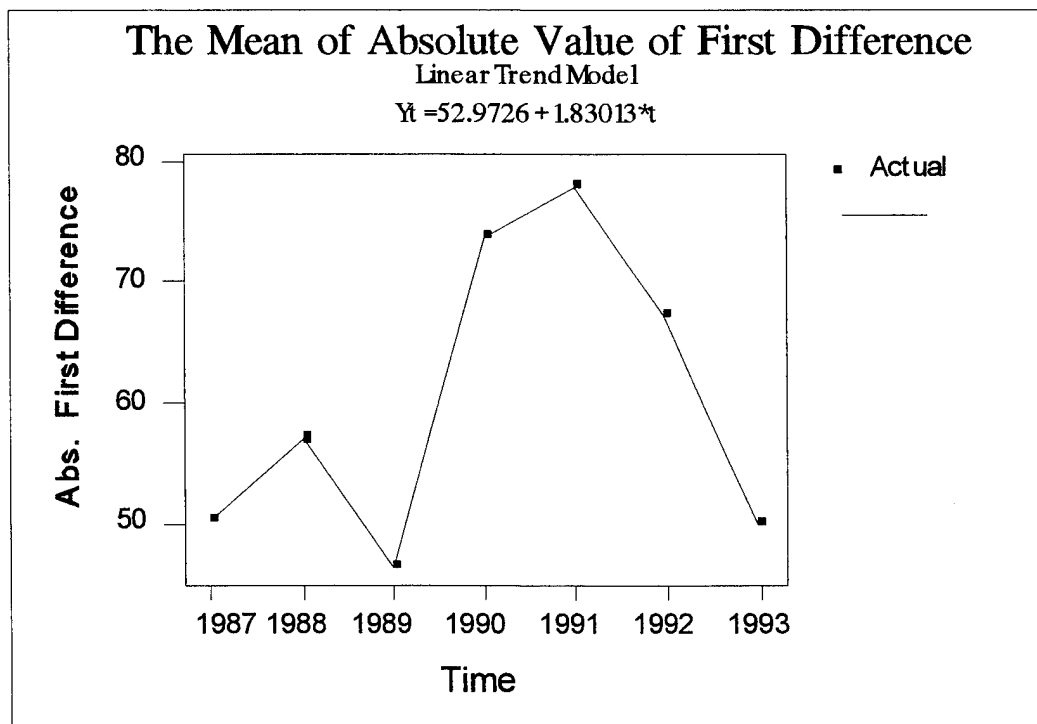


Figure 14. Differences of the Current Ratio

3. Summary

The visual analysis shows the current ratio increasing from 150% in 1986 to 200% in 1993. The statistical test shows the current ratio of export industry did change significantly. This situation suggests the export industry might have increased the liquidity of the current assets and the ability of businesses to meet maturing current obligations, after the NT\$ appreciation.

Visually, the plot of means of absolute first annual differences of the current ratio showed the industry condition unstable from 1987 to 1993.

C. QUICK RATIO

The quick ratio, also known as the acid test ratio or liquidity ratio, provides a more rigorous test of ability to pay than the current ratio. The quick ratio measures immediate solvency (liquidity) and supplements the current ratio. The quick ratio is calculated by deducting inventory from the current asset figure and dividing the result by current liabilities. Inventories typically are the least liquid current asset and as such are subject to the greatest risk of loss in case of liquidation. [Ref. 4: p. 44] The quick ratio is calculated as followed:

- **Quick Ratio** = (Current Assets - Inventories)/Current Liabilities

If a company has a quick ratio of at least 100 percent, some analysts consider it to be in a fairly good current financial condition.

1. Export Industry Condition

The means of the quick ratio of the export industry were calculated and plotted in Figure 15 to display the trend of the ratio during the period of 1986-1993. The plot showed the ratio increasing from 122% in 1986 to 149% in 1990, then decreasing a little to about 138% in 1993. Was the change of the industry condition significant or not? In order to test if the industry condition differed year-to-year significantly or not, the oneway ANOVA test was used. The test result is listed in Table 11.

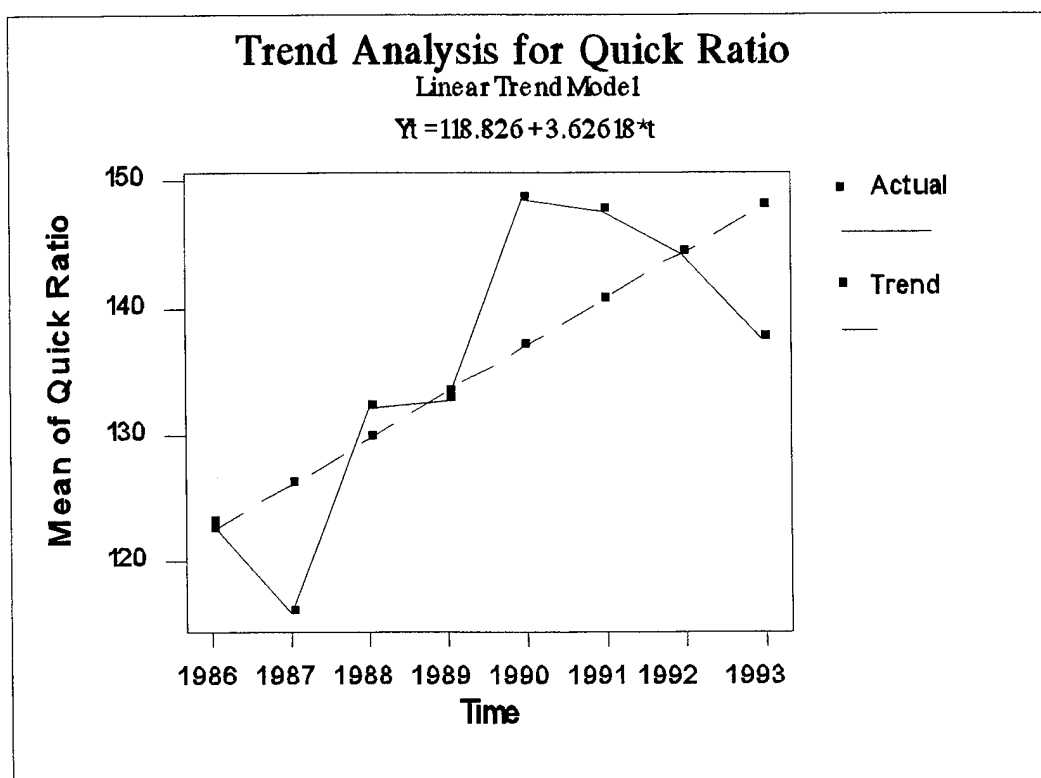


Figure 15. Quick Ratio of the Export Industry

Quick	Ratio	Test	Value
Ratio Level	ANOVA (1986-1993)	F*	0.38
		P	0.914
	T Test	t*	-1.39
		P	0.17

Table 11. ANOVA Quick Ratio

The oneway ANOVA (1986-1993) test at the 95% confidence level showed that the F-value is 0.38 and P-value is 0.914. The null hypothesis of no difference is accepted and there is no significant change in the quick ratio due to NT\$ appreciation.

2. Stability

The F-test shows that the industry financial condition did not change a lot due to the NT\$ appreciation. Was the industry condition stable during the period when NT\$ appreciated? The means of the absolute value of first annual differences of the quick ratio display the overall trend of change in the export industry. The means of absolute first annual differences of the quick ratio were calculated and are plotted in Figure 16. Visually, Figure 16 shows the export industry unstable during 1987 and stable after 1988.

A t-test was used to test whether or not the instability levels changed significantly from 1986 to 1993. The test result is listed in Table 11. Because the t-value is -1.39 and the P-value is 0.17, one can conclude the null hypothesis of equality of the stability levels of 1986-1989 and 1990-1993, at a 95% confidence level.

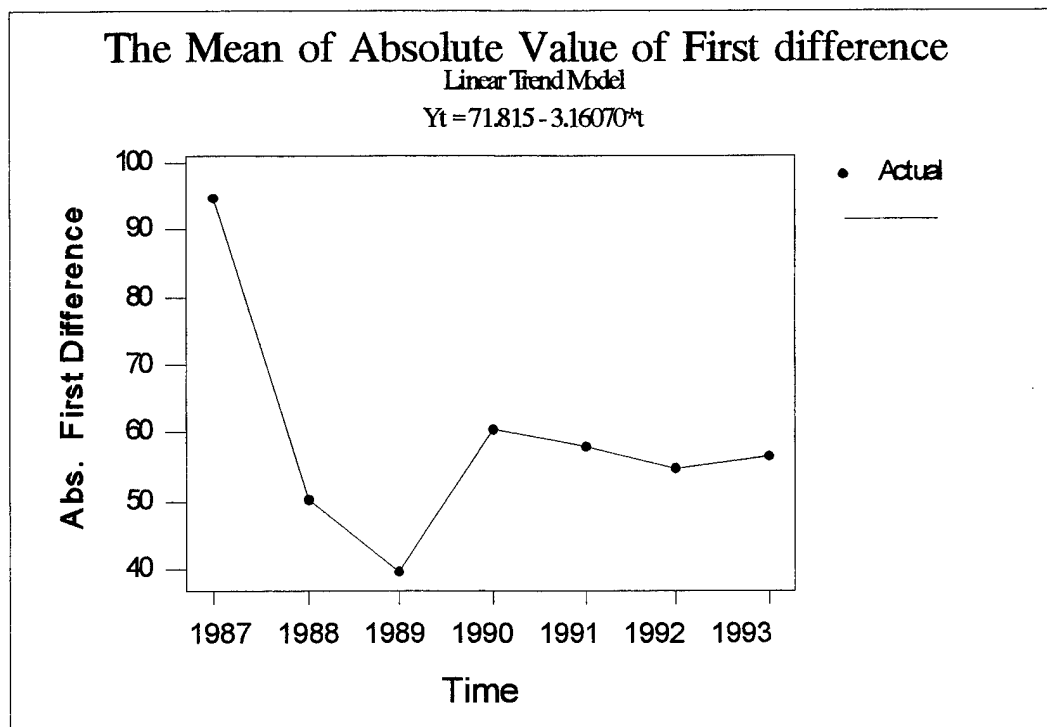


Figure 16. Differences of the Quick Ratio

3. Summary

The visual analysis shows the quick ratio increasing from 122% in 1986 to 138% in 1993. The statistical test shows the quick ratio of the export industry did not change significantly. This situation suggests the export industry increased the liquidity of current assets (except inventories) and kept the ability of businesses to meet maturing current obligations.

Visually, the plot of means of absolute first annual differences of the quick ratio showed the industry condition unstable in 1987. The t-test showed the quick ratio stable during the period 1986-1989 and the period 1990-1993. This situation showed the export industry liquidity was not impacted by the exchange rates.

D. ACCOUNTS RECEIVABLE TURNOVER RATIO

The accounts receivable turnover ratio indicates how soon the firm will collect cash. The ratio reflects the credit and collection activity for possible corrective action. [Ref 3, p 661] The accounts receivable turnover ratio is calculated as followed:

- **Accounts Receivable Turnover** = $\text{Net Sales} / \text{Average Accounts Receivable}$

An overinvestment in receivables, which often exists in periods of recession, may necessitate borrowing on a short-term basis to pay off current liabilities. The larger the amount of receivables, in relation to net sales, outstanding at the end of the accounting period, the greater the amount of uncollectible receivables is likely to be.

A variation in the ratio of accounts receivable turnover from year to year may reflect variations in the company's credit policy or changes in its ability to collect receivables.

1. Export Industry Condition

The means of the accounts receivable turnover ratio of the export industry are calculated and plotted in Figure 17. The plot shows the ratio increasing from 1986 to 1989 and then increasing again from 1990 to 1992. It seems the industry condition has been changed by the NT\$ appreciation. Was the change of the industry condition is significant or not? The ANOVA was used to answer this question.

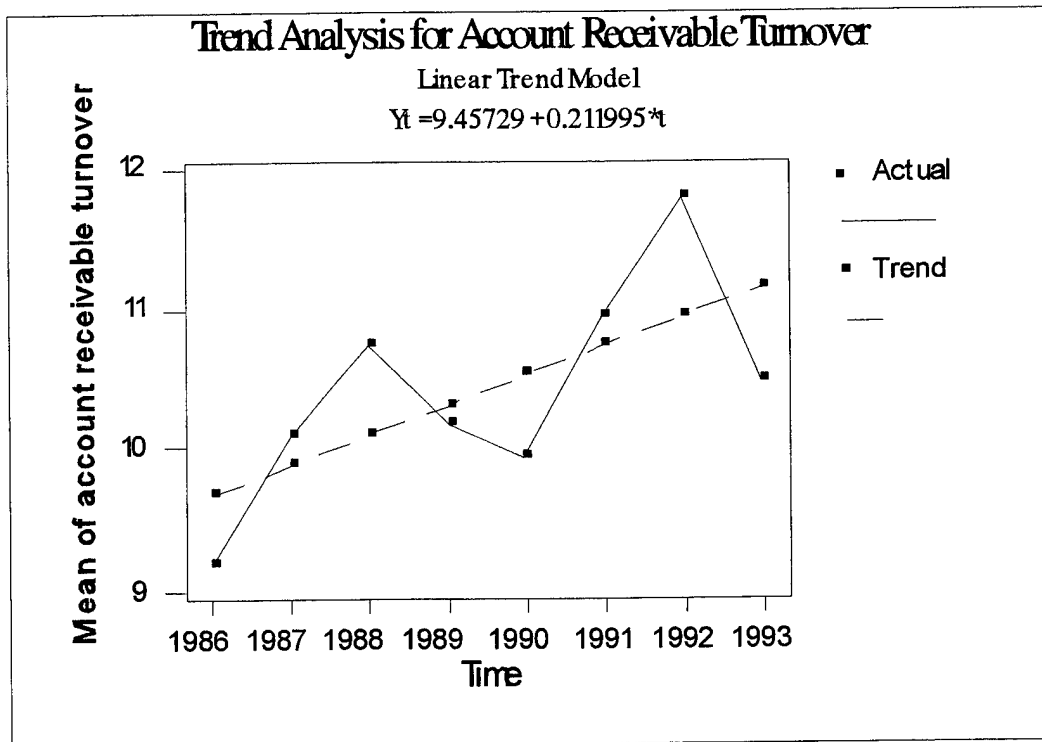


Figure 17. Account Receivable Turnover Ratio of the Export Industry

Account	Receivable	Test	Value
Ratio	ANOVA (1986-1993)	F*	0.6
		P	0.795
Level	T Test	t*	-0.34
		P	0.73

Table 12. ANOVA Account Receivable

The oneway ANOVA (1986-1993) test was used to compare the means of each year's ratio level. The results of the test are listed in the Table 12. The oneway ANOVA test of 95% confidence level showed that the F-value is 0.6 and P-value is 0.795. The null hypothesis of no difference is accepted and it is concluded that year-to-year changes in the account receivable turnover ratio are not significant.

2. Stability

The F-test shows that the industry condition did not change much due to the NT\$ appreciation. Was the industry condition stable during the period when the NT\$ appreciated? The means of the absolute value of first annual differences of the account receivable turnover ratio display the overall trend of change (instability) in the export industry. The means of absolute first annual differences of the account receivable turnover ratio were calculated and are plotted in Figure 19. Visually, the Figure shows the industry unstable in 1987 and again in 1991-92.

A t-test was used to test whether or not the instability levels changed significantly from 1986 to 1993. The test result is listed in Table 12. Because the t-value is -0.34 and the P-value is 0.73, one can accept the null hypothesis of equality of the stability levels of 1986-1989 and 1990-1993, at a 95% confidence level.

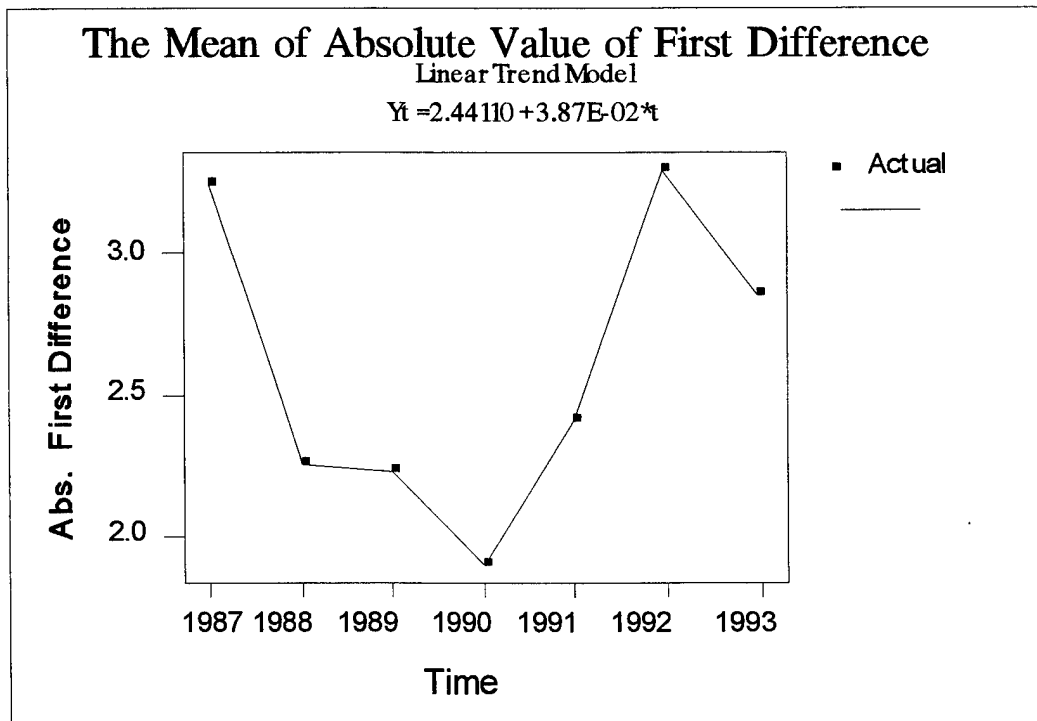


Figure 18. Differences of the Account Receivable Turnover Ratio

3. Summary

The visual analysis shows the account receivable turnover ratio increasing from 9 times in 1986 to 12 times in 1992, which might suggest the export industry has changed in its ability to collect receivables. However, the statistical test shows the accounts receivable turnover ratio of export industry did not change significantly.

Visually, the plot of means of absolute first annual differences of the accounts receivable turnover ratio showed the industry condition unstable during 1987 and again at 1991- 1992. But the t-test showed no significant instability during 1986-89 and 1990-93. This situation suggest the export industry adjusted the policy to collect receivables and was not impacted by the exchange rates.

E. SUMMARY FOR LIQUIDITY RATIO

The current ratio and quick ratio show that Taiwan's export industry increased liquidity and the ability of businesses to meet maturing current obligations. Visually, the plot shows the accounts receivable turnover ratio increasing a little from 1986 to 1993, which might indicate that the export industry has changed in its ability to collect receivables.

VII. LEVERAGE

A. INTRODUCTION

Financial leverage ratios, also known as solvency or debt ratios, were developed by analysts to accomplish the following: (1) to provide insight into how much debt a firm is employing relative to equity, (2) to help evaluate a firm's ability to raise debt, (3) to assist one in judging a firm's ability to pay its debt when it is due. [Ref. 4: p. 35] Leverage ratios also measure the degree to which the firm has utilized debt financing in its financial structure. These ratios provide information about the business risk and the financial flexibility of the firm. When the degree of leverage is too large for a firm, the degree of risk that the firm cannot pay interest and debt increases. In general, firms with low leverage have reduced the risk of not being able to meet their cash outflows when the economy is in recession, but, at the same time, they forgo the opportunity of large gains through the use of leverage in periods of upswings. Therefore, the firms have to balance the expected return against increased risk. [Ref. 4: p. 45]

B. EQUITY TO DEBT RATIO

This ratio measures how many dollars of debt are being used for each dollar of equity. When the ratios exceed 100%, it means that the capital provided by the stockholders exceeds that provided by the lenders. The equity to debt ratio is determined by dividing the stockholders' equity by the total liabilities. The ratio is calculated as follows:

- **Equity to Debt** = $\text{Stockholders' Equity} / \text{Total Liabilities}$

Lenders prefer to see a high ratio as insurance that the company is able to repay its debts. But owners seeking leverage in their capitalization structure prefer a low ratio. The higher the debt, the greater the risk that the company will find itself in trouble if sales cannot be maintained at normal levels. [Ref. 1: p. 43]

1. Export Industry Condition

The means of the equity to debt ratio of the export industry are calculated and plotted in Figure 19 to display the trend of the ratio during the period of 1986-1993. The plot shows

the ratio increasing from 45% in 1986 to 65% in 1990, then decreasing a little to 60% in 1993. It seems the export industry has been changed by the NT\$ appreciation. In order to test if the industry condition differed year-to-year significantly or not, the oneway ANOVA test was used. The test result is listed in Table 13.

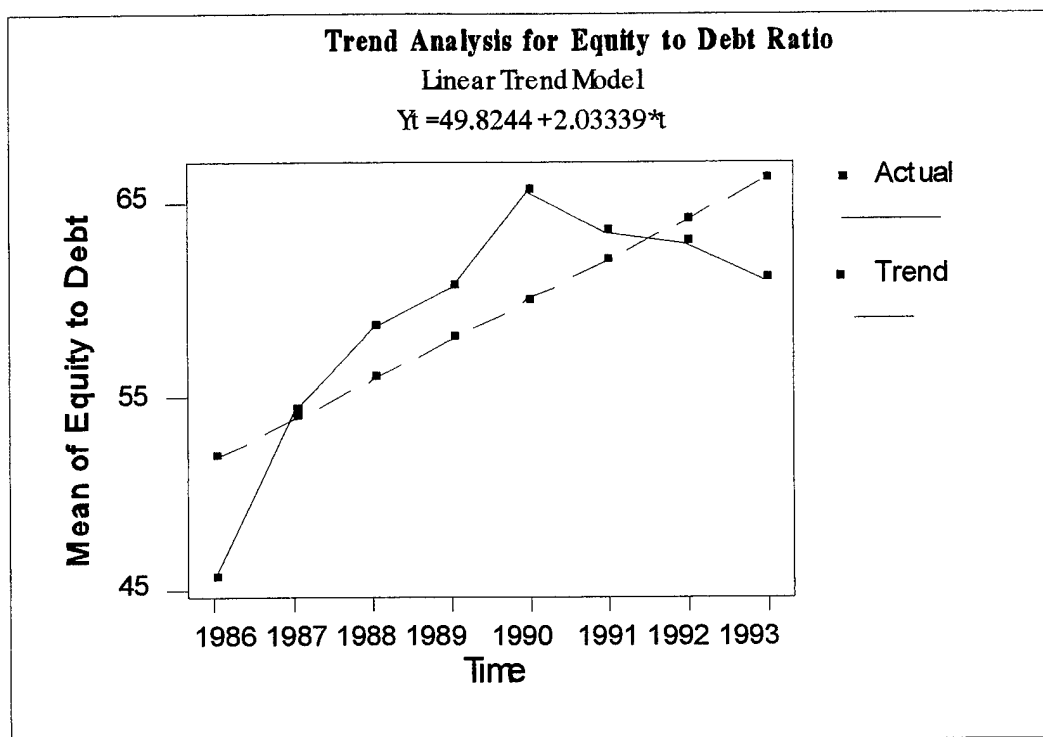


Figure 19. Equity to Debt Ratio of the Export Industry

Equity	to Debt	Test	Value
Ratio Level	ANOVA (1986-1993)	F*	7.23
		P	0.0001
	T Test	t*	-5.1
		P	0.0001

Table 13. ANOVA Equity to Debt Ratio

The oneway ANOVA (1986-1993) test was used to compare the means of each year's ratio level. The ANOVA (1986-1993) of Table 13 shows that the F-value is very large and the p-value is less than 0,001. The test result shows that the null hypothesis is rejected at a 95% confidence level and it is concluded that there was significant change in the industry condition due to NT\$ appreciation.

2. Stability

The F-test shows that the industry condition has changed since NT\$ appreciated. Did the industry condition stabilize during the period when NT\$ appreciated slowly? The means of absolute value of first annual differences of the equity to debt ratio display the overall trend of change (instability) in the export industry. The means of absolute first annual differences of the equity to debt ratio was calculated and is plotted in Figure 20. The plot shows the industry unstable during 1987. Visual inspection of Figure 20 shows the export industry more stable during the 1990-1993 period than during 1986-1989 period.

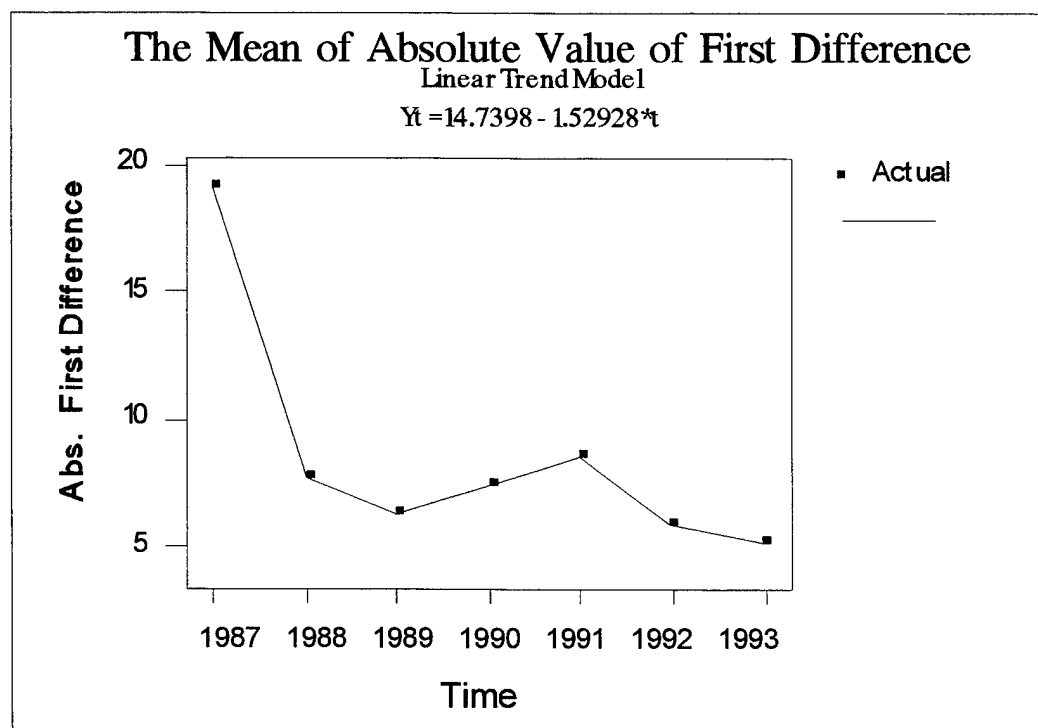


Figure 20. Differences of the Equity to Debt Ratio

A t-test was used to test whether or not the instability levels changed significantly from 1986 to 1993. The test result is listed in Table 13. The t-value is very large and the p-value is less than 0,001. The result from the t-test rejects the null hypothesis of equality of the stability levels of 1986-1989 and 1990-1993, at a 95% confidence level.

3. Summary

Taiwan's export industry experienced increasing equity to debt ratios due to the exchange rate appreciation. The visual analysis and statistical tests showed the increase in the equity to debt ratio values. Those analyses show that the industry condition changed a lot and the industry increased stockholders' equity or decreased debt and became less risky after the period of the NT\$ appreciation.

Visually, analysis of the plot of the means of absolute first annual differences showed that the industry was unstable only in 1987.

C. DEBT RATIO

A debt ratio compares what is owed to the value of assets used by the business. It is used to predict long-term solvency. The purpose of debt ratios is to help identify problems with respect to raising and servicing debt. The debt ratio is calculated as follows:

- **Debt Ratio** = Total Liabilities/Total Assets

Debt varies greatly from firm to firm. Firms with low debt ratios are less risky, but they also forgo the opportunity to leverage up their return on equity. Firms with relatively high debt ratios have higher expected returns, however, they are exposed to higher risk. The large increase in debt ratios is a hint that the firm might not be able to raise more debt if it is needed. Moreover, it might be that the firm will have difficulty paying its debt as they fall due.
[Ref. 5: p. 56]

1. Export Industry Condition

The means of the debt ratio of the export industry are calculated and plotted in Figure 21. The plot shows the ratio decreasing from 43% in 1986 to 34% in 1990 and stabilizing about 37% during 1991-1993. It seems the industry condition has been changed by the NT\$

appreciation. Was the change of the industry condition significant or not? The ANOVA was used to answer this question.

The oneway ANOVA (1986-1993) test was used to compare the means of each year's ratio level. The test result is listed in Table 14. The oneway ANOVA (1986-1993) test of 95% confidence level showed that the F-value is 2.29 and P-value is 0.027 which is beyond the 95% confidence level. The null hypothesis of no difference is rejected and it is concluded that there was significant change in the debt ratio due to NT\$ appreciation.

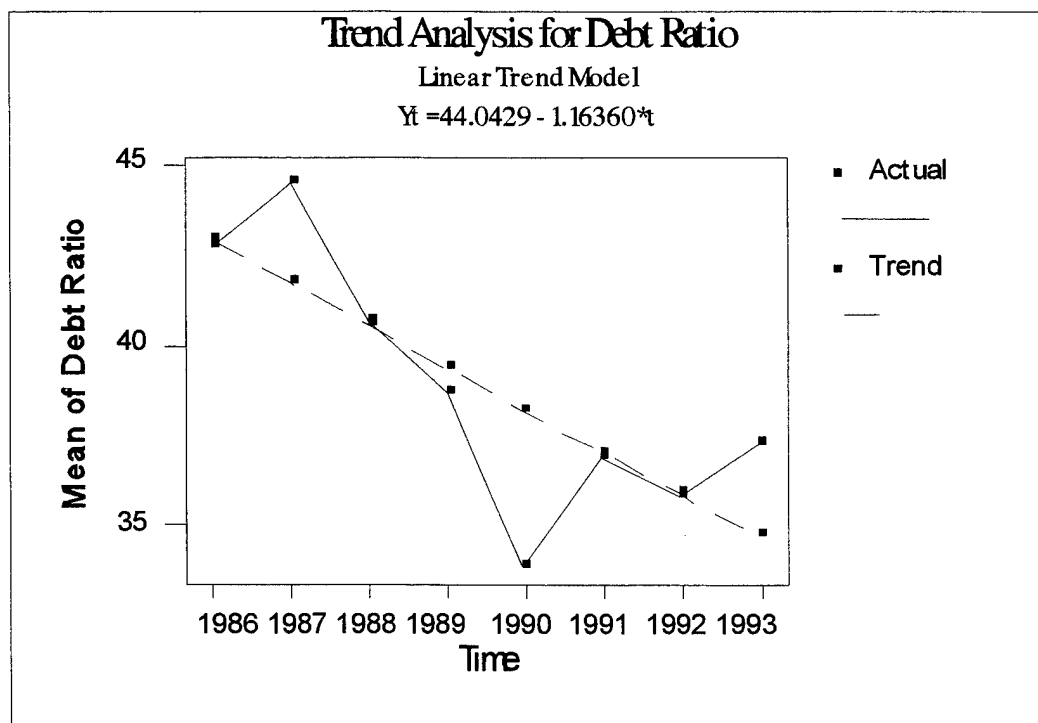


Figure 21. Debt Ratio of the Export Industry

Debt Ratio		Test Value	
Ratio Level	ANOVA (1986-1993)	F*	2.29
		P	0.027
	T Test	t*	3.61
		P	0.0004

Table 14. ANOVA for Debt Ratio

2. Stability

The F-test shows that the industry condition has changed since the NT\$ appreciation. Did the industry condition stabilize during the period when NT\$ appreciated? The means of absolute value of first annual differences financial ratios display the overall trend of change (instability) in the export industry. The means of absolute first annual differences of the debt ratio were calculated and are plotted in Figure 22. The plot shows both periods of stability and instability in the industry from 1986 to 1993. Was the export industry more stable during the 1990-1993 period than during 1986-1989 period?

A t-test was used to test whether or not the instability levels changed significantly from 1986 to 1993. The test result is listed in Table 14. The t-value is very large and the p-value is less than 0,001. The result from the t-test rejects the null hypothesis of equality of the stability levels of 1986-1989 and 1990-1993, at a 95% confidence level.

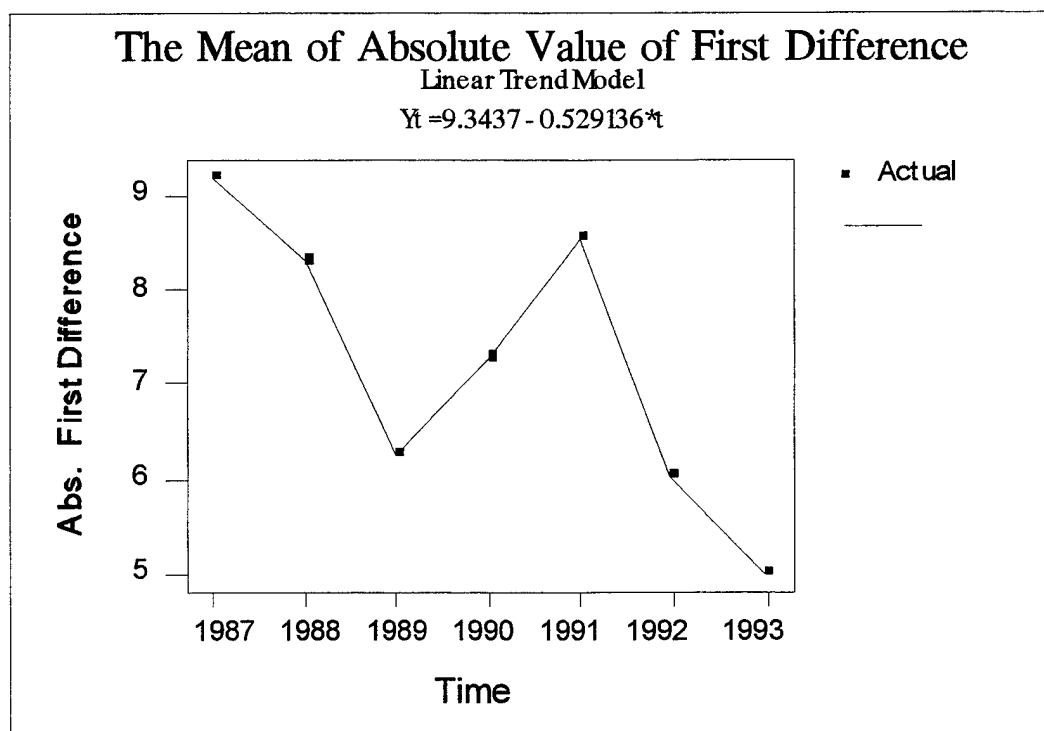


Figure 22. Differences of the Debt Ratio

3. Summary

Taiwan's export industry experienced declining debt ratios due to the exchange rate appreciation. The visual analysis and statistical tests showed the deterioration in the debt ratio. Those analyses show that the industry condition changed and the industry reduced the opportunity to leverage up their return on equity. Also, the visual analysis and statistical tests showed the debt ratio of export industry unstable from 1986 to 1993.

D. TIMES INTEREST EARNED

The times interest earned ratio, also known as interest coverage ratio, is designed to help one evaluate a firm's capacity to meet interest payment. The times interest earned ratio is calculated as follows:

$$\bullet \text{ Times Interest Earned} = (\text{Earnings before Taxes plus Interest}) / \text{Interest Charges}$$

This ratio attempts to indicate the relative protection of bondholders and to assess the probability of a firm's failing to meet required interest payments. Failure to meet this obligation can bring legal action by the firm's creditors, possibly resulting in bankruptcy. The lower this ratio, the higher the probability that a firm will encounter financial distress. [Ref. 3: p. 568]

1. Export Industry Condition

The means of the times interest earned ratio of the export industry are calculated and plotted in Figure 23. The plot shows the times interest earned ratio increasing dramatically from 20 in 1989 to 65 in 1990. It seems the export industry has been changed by the NT\$ appreciation. Was the change in the industry condition is significant or not? The oneway ANOVA test was used to answer this question. The results of the test are listed in the Table 15. The oneway ANOVA test was used to compare the means of each year's ratio values. The oneway ANOVA test of 95% confidence level showed that the F-value is 0.71 and P- value is 0.665. Then the null hypothesis of no difference is accepted and it is concluded that year-to-year changes in the times interest earned ratio are not significant.

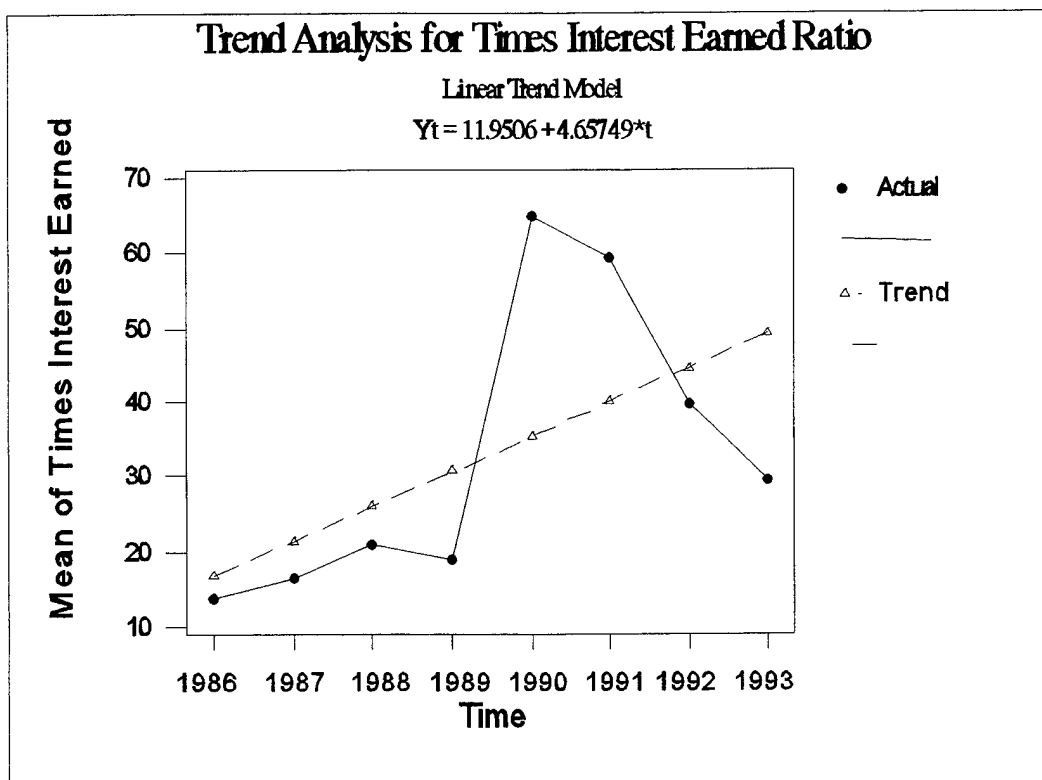


Figure 23. Times Interest Earned Ratio of the Export Industry

Times	Interest earned	Test	Value
Ratio	ANOVA (1986-1993)	F*	0.71
		P	0.665
Level	T Test	t*	-1.49
		P	0.14

Table 15. ANOVA Times Interest Earned

It seems that the results from statistical test are contradictory to the outcome of visual of inspection Figure 23. Not only the Figure 23 shows the means of ratio increasing dramatically from 20 in 1989 to 65 in 1990 was one-time effect, but the statistical test shows the deviation of means of 1990-1993 are very large. There two phenomena result in a large

deviation of annual means might explain the means of the ratio of 1986-1993 are not statistically different because of the large deviation of the mean values.

2. Stability

The F-test shows that the industry condition has not significantly changed since the NT\$ appreciation. Did the industry condition stabilize during the period when NT\$ appreciated? The means of the absolute value of first annual differences of the times interest earned ratio display the overall trend of change (instability) in the export industry. The means of absolute first annual differences of the time interest earned ratio were calculated and plotted in Figure 24. The plot shows the industry unstable from 1987 to 1989 and becoming more stable after 1990, which means the export industry instability during 1986-1990 was related to the NT\$ appreciation.

A t-test was used to test whether or not the instability levels of the export industry changed significantly from 1986 to 1993. The test result is listed in Table 15. Because the t-value is -1.94 and the P-value is 0.14, one can not reject the null hypothesis of equality of the stability levels of 1986-1989 and 1990-1993, at a 95% confidence level.

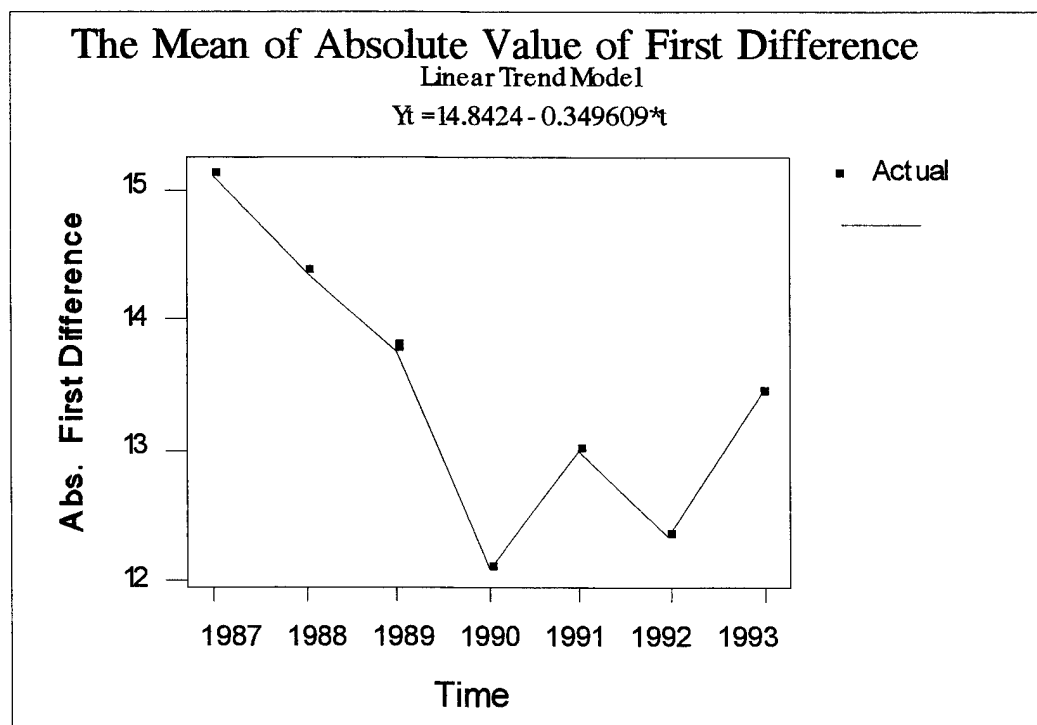


Figure 24. Differences of the Times Interest Earned Ratio

3. Summary

Visually, the plot of the times interest earned ratio of Taiwan's export industry showed the industry was impacted by the NT\$ appreciation. But the statistical test showed the ratio of export industry did not change from year to year. In general, the plot shows the ratio increasing which means the export industry's capacity to meet interest payment increased.

Visually, the plot of means of absolute first annual differences of the times interest earned ratio showed the export industry unstable from 1986 to 1989. But the statistical test showed equality of the stability during the two periods of 1986-1989 and 1990-1993.

E. SUMMARY FOR LEVERAGE RATIO

The equity to debt ratio and debt ratio show that Taiwan's export industry decreased in utilizing debt financing in its financial structure during the period of NT\$ appreciation, when compared to the period when the NT\$ did not appreciate. Those two ratios show the export industry had less risk. The times interest earned ratios also shows that the export industry increased its ability to pay interest to creditors.

VIII. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

This study statistically tests the financial ratios for the period from 1986 to 1993 to determine the impact of the exchange rate appreciation from 40 NT\$ in 1986 to 26.5 NT\$ in 1990. The exchange rate remained flat at 26.5 NT\$ from 1990 to 1993.

1. Profitability

Profitability ratios show that the industry performed poorly, with decreasing earnings and poor return on resources committed to the business. This is because the export industry was affected greatly by the NT\$ exchange rate from 1986-1993. The period from 1986 to 1990 shows a decreasing trend for profitability that only flattened out when the exchange rate reached 26.5. This shows that the export industry profitability is directly tied to the exchange rate. The R.O.C. competitiveness in the world market for these products has decreased over the same period because of appreciation of the NT\$. If the NT\$ resumes its appreciation it would be expected that the R.O.C. exports will become even less competitive.

2. Activity

Activity ratios show the industry was somewhat impacted in controlling inventory turnover by the exchange rate appreciation. This may explain the sales decrease. But the fixed asset turnover ratio was deeply impacted by the exchange rate appreciation. This may result from decreasing sales or inefficient use of fixed assets.

3. Liquidity

The means plots of the current and quick ratios show the industry increasing the liquidity of the current assets, indicating as increased ability to meet maturing current obligations. But statistical tests show that they were impacted little by the exchange rate appreciation. Also, the plot shows that current receivable turnover ratios increased. This might be explained by the industries adjusting their policy for collected receivables to one more suited to the changed environment. Statistical tests show these ratios were not impacted

by the exchange rate appreciation. This may indicate the industry adjusted its liquidity ratios owing to environmental changes. But the adjustment was very small.

4. Leverage

The debt ratios decreased and the equity to debt ratio increased during 1986 to 1993, which showed the industry decreased in utilizing debt to finance business activity. The times interest earned ratio increased and combined with the other two ratios showed the industry decreased its risk in debt utilization. This showed the industry changed its debt policy and the industry waived the opportunity to leverage up their return on equity.

5. Results

Shown in Table 16 are the results of the study. They indicate that generally that R.O.C. export industries have been more stable from 1990 to 1993. This is a result of the stabilization of the NT\$ at a level of 26.5. The R.O.C. has the largest foreign exchange reserves in the world. Recently, the NT\$ has appreciated to a value of 25.4. This indicates that R.O.C. export industries could again enter a period of appreciating exchange rate for the NT\$.

The R.O.C. must maintain a strong and profitable economy in order to meet its historical threat from mainland China. The engine that drives the R.O.C. economy is its export industries. These industries account for 60% of the R.O.C.'s GNP. Therefore, in order for the R.O.C.'s economy to remain strong, its export industries must be profitable and efficient.. The R.O.C., in the future, will experience even more intense competition in its export market from the countries of East Asia, mainly, South Korea, Hong Kong, Singapore and especially competition from mainland China, which competes directly with the R.O.C. in textile and steel in the world market for those commodities.

B. RECOMMENDATIONS

- R.O.C. has in the recent past concentrated its efforts at upgrading technology and increasing its competitiveness in its export electronics industry. The government of the R.O.C. should widen its focus to include the textile and plastics industries, these industries employ the largest numbers of workers and produce the most foreign exchange. These industries are also the first of the export industries that will become unprofitable with the appreciation of the NT\$ because they are in

competition with other countries which have lower labor rates and less restrictive environmental laws. The R.O.C. should upgrade the technology and productivity of these industries by moving them to higher value products which produce a greater return for the labor used in production. Of particular concern is the plastics industry which without an upgrade in technology and product produced will not only become unprofitable but produce environmental problems in the future.

- The R.O.C. should assist its export industries to acquire capital to make improvements in technology and efficiency so that they will be competitive in the world market. Government generally do this by making money more available with low interest rate loans or by reducing the tax burdens of the industries targeted for improvement. The R.O.C. should use its monetary policies and financial policies to make its export industries more competitive in the world market.

Financial Ratio	Has the industry condition significantly changed during the appreciation of NT\$ from 1986 ~ 1993?	Was the stability of the financial condition of the export industry related to the stability of the NT\$? More specifically, was the financial condition of the export industry more stable during the 1990-1993 period than during the 1986-1989?
Profitability		
Gross Margin	Yes, decreased	Yes
Operating Margin	Yes, decreased	Yes
Return on Sales	Yes, decreased	Yes
Return on Assets	Yes, decreased	Yes
Activity		
Inventory Turnover	No	No
Fixed Asset Turnover	Yes, decreased	Yes
Liquidity		
Current Ratio	No	Yes
Quick Ratio	No	No
Accounts Receivable Turnover	No	No
Leverage		
Equity to Debt	Yes, increased	Yes
Debt Ratio	Yes, decreased	Yes
Times Interest Earned	No	No

Table 16. Results of Study

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